NORTHEAST ELECTRONICS

A DIVISION OF NORTHERN TELECOM, INC.

INSTRUCTION MANUAL

TTS-35 SERIES TRANSMISSION TEST SETS

COVERS: 35B, 35BR, 35BAQ, 35XDT, 35XPS, 35XV

No. A0035-20-600 ISSUE 2 DATE MAR 1973

PRINTED IN U.S.A.

Airport Rd., Concord, N.H. 03301 • (603) 224-6521 • TELEX 94-3453

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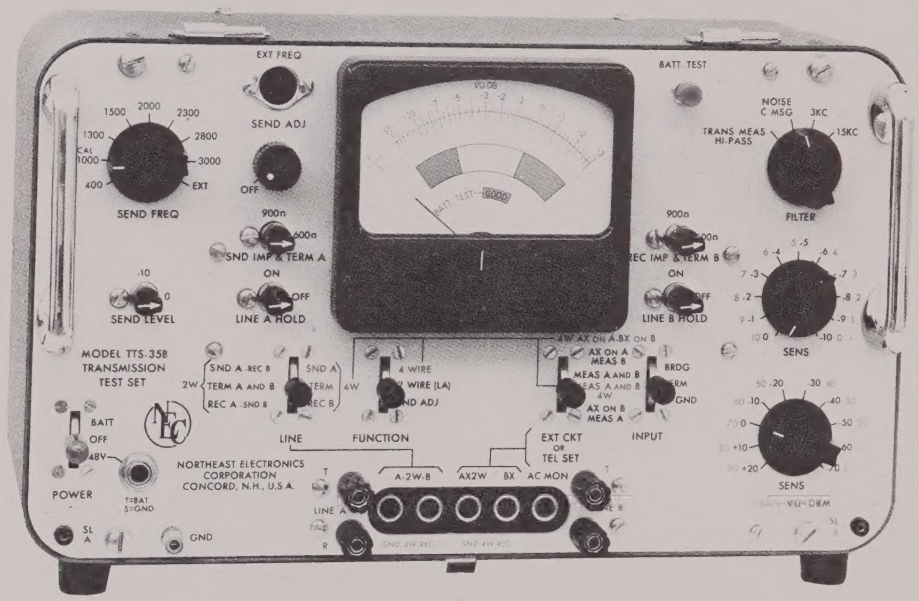

Figure 1–1. Model TTS 35B Transmission Test Set

SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Corporation Model TTS 35B (Figure 1-1) is a portable, battery operated test instrument that performs transmission tests and noise and VU measurement over telephone circuits ranging from local exchange loops to four-wire toll and special service circuits. The instrument contains an oscillator, a meter amplifier, hold coils, input filters, precision terminations and switching circuitry that selects the test and power functions. The Model TTS 35BR is a rack mounted version of the TTS 35B.

1.3 Connections to the send and receive sections of the TTS 35B/BR are made via standard telephone type (310) jacks and binding posts that are centrally arranged along the lower edge of the front panel. Switchable hold coil circuits are provided for the Line A and Line B jacks.

1.4 The send oscillator contained within the TTS 35B/BR is capable of supplying eight fixed frequencies at continuously variable output levels ranging from +3 dBm to −40 dBm. Two additional fixed frequencies are optional and an external frequency-determining cover accessory in the form of the Model TTS 35XV is available to provide continuously variable output frequencies from 200 Hz to 7000 Hz. The output of the oscillator is ac coupled and an output impedance of 600 or 900 ohms can be selected.

1.5 The receive section measures a wide range of transmission levels, VU and noise and displays measurement results on the 4½ inch mirror scale meter centrally located on the front panel. The meter provides red,yellow, and green arcs for VU measurements, a VU-DB scale calibrated from +3 dB to −15 dB, a dBrn scale calibrated from +13 dBrn to −5 dBrn, and a green arc to facilitate battery testing.

1.6 The overall sensitivity of the receive section can be varied from −80 dBm to +20 dBm (0 dBrn to 100 dBrn) by means of two sensitivity switches located on the lower right corner of the front panel. For identification the dBm settings on the sensitivity switches are marked in black, the dBrn settings in blue.

1.7 Four switchable input filters are provided to attenuate low frequency energy near 60 Hz, attenuate high frequency energy occurring above the voice band, or provide C-message weighting.

1.8 The input of the TTS 35B/BR is ac coupled and balanced. A quiet termination (900 ohms +2μF) is provided as well as the standard termiantions of 900 ohms, 600 ohms, and approximately 15,000 ohms in the bridging input mode.

1.9 The TTS 35B can be operated from twelve internal 1.5 volt D cells or from the 48 volt office battery. In the latter case the circuitry contained within the TTS 35B is protected against polarity reversals at the power input to prevent accidental damage to the instrument. Internal batteries are not used with the TTS 35BR, but 48 volts dc may be applied through the 48V jack on the front panel or via a connector strip on the back of the front panel.

1.10 A monitor jack in the receive circuitry provides an ac output to drive external circuitry, such as impulse noise measuring equipment, or a telephone headset to determine the nature of the input signal, thereby employing the TTS 35B/BR as a variable, high gain amplifier.

1.11 The material in this manual applies equally to the TTS 35B and TTS 35BR, except for instructions relating to internal battery test, replacement, and turn-on procedure.

1.12 ACCESSORIES.

1.13 TTS 35XDT DIAL AND TALK ADAPTER. Refer to Appendix 1 for complete data. The TTS 35XDT provides a convenient means of dialing and talking on the subscriber line being tested by the TTS 35B.

1.14 TTS 35XPS AC POWER SUPPLY ADAPTER.

1.15 Refer to Appendix 2 for complete data. The TTS 35XPS permits use of the TTS 35B without internal batteries or access to a central office battery.

1.16 TTS 35XV CONTINUOUSLY VARIABLE FREQUENCY ADAPTER.

1.17 Refer to Appendix 3 for complete data. The TTS 35XV enables continuously variable frequency coverage from the TTS 35B.

SECTION 2

SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2-1 lists the specifications of the Models TTS 35B and TTS 35BR. Figures 2–1 and 2–2 illustrate the response of the filters.

Table 2–1. Specifications

RECEIVE SECTION	
METER CALIBRATION	
Level Measurements:	+3 dB to –15 dB
Noise Measurements:	+13 dBrn to –5 dBrn
Scale:	0.2 dB div from +3 dB to –3 dB and +13 dBrn to +7 dBrn 0.5 dB div from –3 dB to –10 dB and 0 dBrn to +7 dBrn 1.0 dB div from –10 dB to –15 dB and 0 dBrn to –5 dBrn
Tracking Accuracy:	±0.15 dB +3 dB to –3 dB
RANGE OF MEASUREMENTS	
Level Measurements:	+23 dBm to –95 dBm
Noise Measurements:	+113 dBrn to –5 dBrn
Noise to Ground Measurements:	+113 dBrn to –5 dBrn on meter (Actual noise to ground 40 dB higher than measured value).
MONITOR OUTPUT	
Output Impedance:	600 ohms
Output Level:	–10 dBm, ±1.0 dB when meter reads 0 dBrn
Maximum Output:	–2.0 dBm
INPUT IMPEDANCES (Balanced input transformer)	
Terminated:	600 or 900 ohms ±5% with a phase angle of less than 5° when hold coil is out
Bridging:	15,000 ohms
Longitudinal drain:	Across the line – 85,000 ohms To ground – 100,000 ohms
FREQUENCY RESPONSE (The frequency response of the receive section is determined by switch selection of one of the following filters.)	
C Message:	Normalized for zero insertion loss at 1 kHz
High Pass:	±1 DB 700 Hz to 5 kHz Attenuation 0.5 dB nominal at 300 Hz, 3 dB at 13 kHz and ⩾25 dB at 60 Hz
3 KC:	±0.2 dB 600 Hz to 2 kHz Attenuation 3 dB nominal at 3 kHz HF cutoff characteristic 18 dB per octave

Table 2–1. Specifications (cont)

15 KC:	±0.2 dB 100 Hz to 5 kHz Attenuation 3 dB nominal at 15 kHz HF cutoff characteristic 18 dB per octave
The reference frequency for filter specifications is 1 kHz. A typical frequency response curve for each filter is shown in Figures 2–1 and 2–2.	
ACCURACY (Overall measurement error at 1 kHz at ordinary room temperature and with good batteries will not exceed ±0.2 dB.)	
Attenuator Accuracy:	±0.15 dB
Temperature Error:	±0.15 dB maximum at 1 kHz for temperatures from 30°F to 120°F, with respect to readings taken at 72°F.
Battery Voltage Error:	±0.1 dB maximum for battery voltage reading within the green BATT TEST arc on the meter scale.

SEND SECTION

FREQUENCIES (eight frequencies selected by a switch):	400,1000,1300,1500,2000,2300,2800, and 3000 Hz + EXT. Two additional frequencies can be supplied.
Frequency Accuracy:	2% from 50°F to 100°F
Distortion:	Less than 1% at any harmonic
Output Level:	Can be set by means of the SEND ADJ control and calibrated from any level from +3 dBm to −40 dBm . The maximum level variation when switching frequencies is ±0.2 dB.
Output Impedance:	600 ohms or 900 ohms selected by switch
Line Jacks:	Switchable hold coil and DC blocking provided.
POWER REQUIREMENTS	
Battery Operation:	Requires twelve 1.5 volt D cells, which are accessible from the bottom of the unit.
Battery Life:	Intermittent use approximately 130 hours.
48 Volt Operation:	Requires 48 volt central office battery, current drain 84 mA.
SIZE	
Model TTS 35B:	14 in.w x 8¾ in.h x 8 in. d
Model TTS 35BR:	19 in.w x 8 23/32 in. h x 6 in. d
WEIGHT	19½ pounds.

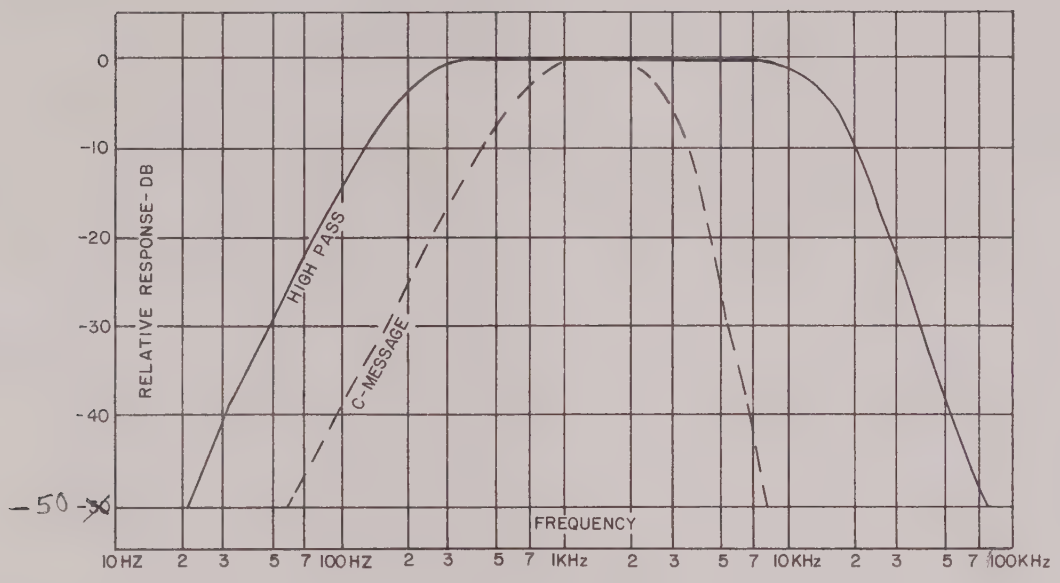

Figure 2–1. TTS 35B/BR High Pass and C-Message Filters, Frequency Response Curves.

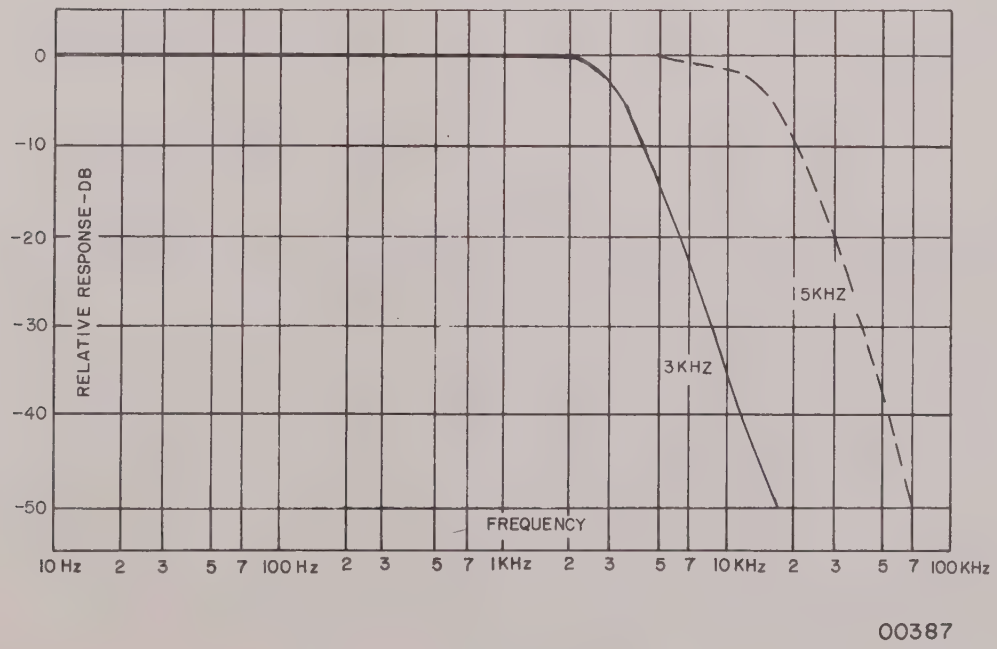

Figure 2–2. TTS 35B/BR 3 kHz and 15 kHz Filters, Frequency Response Curves.

SECTION 3

OPERATION

3.1 INTRODUCTION.

3.2 Table 3–1 lists the functions of all the controls,connectors and indicators called out on figure 3–1. Paragraphs 3.3 through 3.30 provide the operating instructions.

Table 3–1. Functions of Front Panel Controls,Indicators and Connectors

REFERENCE DESIGNATOR	CONTROL,INDICATOR OR CONNECTOR	FUNCTION
E1,E2	LINE A T and R binding posts	Provide parallel connections to A jack J1, tip and ring.
E3,E4	LINE B T and R binding posts	Provide parallel connections to B jack J2, tip and ring.
E5	GND binding post	Provides chassis ground for noise-to-ground measurements.
J1,J2	A-2W-B jacks	Provide access to send and receive circuitry as selected by switches S3 and S5, described below.
J3,J4	AX2W BX jacks	Provide parallel connections to jacks J1 and J2, described above, as selected by switch S5, described below.
J5	48V T= BAT S = GND jack	Provides power connection for 48V external source.
J6	AC MON jack	Provides access to receive circuitry for external measuring equipment or headset.
J7	EXT FREQ connector	Provides connection for external frequency determining accessory TTS 35XV.
M1	VU-DB meter	Indicates send level (see switch S4) receive level (see switches S8 and S10) and battery voltage (see switch S11).
PJ1	SL B pin jack	Provides connection to sleeve of B jack J2.
PJ2	SL A pin jack	Provides connection to sleeve of A jack J1.
R101/S13	SEND ADJ control (switch and potentiometer)	In the OFF position, switch S13 removes power from the send circuitry. In any other position, potentiometer R101 provides continuously variable output level from the oscillator section of the send circuitry.
S1	LINE A HOLD switch	In the ON position, connects hold coil across A jack J1.
S2	LINE B HOLD switch	In the ON position, connects hold coil across B jack J2.
S3	LINE switch	Controls the status of the send and receive circuitry during 2-wire and 4-wire measurements as follows: On 2-wire circuits: 1. SND A-REC B: Connects the output of the oscillator to A jack J1 and the input of the receiver to B jack J2. 2. TERM A and B: Connects a quiet termination of either 600 ohms + 2μF or 900 ohms + 2μF, depending on the position of switches S6 and S16, to A and B jacks J1,J2.

Table 3–1. Functions of Front Panel Controls, Indicators and Connectors (cont)

REFERENCE DESIGNATOR	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
		3. REC A-SND B: Connects the input of the receiver to A jack J1 and the output of the oscillator to B jack J2. On 4-wire circuits: 1. SND A: Connects the output of the oscillator to A jack J1 and terminates B jack J2 into the receiver. 2. TERM: Connects a 600 ohm +2 μF or 900 ohm +2μF termination, depending on the position of S6 and S16, to A and B jacks J1 and J2. 3. REC B: Connects the input of the receiver to B jack J1 and terminates A jack J2 with a 600 ohm +2μF or 900 ohm +2μF termination, depending on the position of S16.
S4	FUNCTION switch	Provides the following modes of measurement: 2 WIRE, 4 WIRE and SND ADJ. In the latter mode the output of the oscillator is connected to the input of the receiver to allow the desired output level to be set up by SEND ADJ control R101.
S5	EXT CKT OR TEL SET switch	Controls connection of AX and BX jacks J3 and J4 to A and B jacks J1 and J2 during 2-wire and 4-wire measurements, as follows: On 2-wire circuits: 1. AX ON A MEAS B: Connects A jack J1 to AX jack J3 for the connection of an external dial or tel set to LINE A. Allows measurements to be made on B jack J2 as selected by LINE switch S3. 2. MEAS A AND B: In this position, send/receive connections for A and B jacks J1 and J2 are controlled by LINE switch S3. 3. AX ON B MEAS A: Connects B jack J2 to AX jack J3 for the connection of an external dial or tel set to LINE B. Allows measurements to be made on A jack J1 as selected by LINE switch S3. On 4-wire circuits: 1. 4W AX ON A-BX ON B: Connects AX jack J3 to A jack J1 and BX jack J4 to B jack J2 for the connection of an external dial or tel set to the LINE A and LINE B jacks. 2. MEAS A AND B 4W: In this position, send/receive connections for A and B jacks J1 and J2 are controlled by LINE switch S3.
S6	REC IMP & TERM B switch	Selects receiver input impedance of 600 ohms or 900 ohms, and selects 600 ohms +2μF or 900 ohms +2μF quiet termination for connection to B jack J2 via switch S3.

Table 3–1. Functions of Front Panel Controls,Indicators and Connectors (cont)

REFERENCE DESIGNATOR	CONTROL,INDICATOR OR CONNECTOR	FUNCTION
S7	INPUT switch	Selects the receiver input impedance required for bridged (BRDG), terminated (TERM), or noise-to-ground (N-GND) measurements. In the TERM position, impedance is as selected by switch S6.
S8,S10	SENS switches	Increase the range of measurements possible with meter M1 by adjusting the receiver sensitivity. Algebraic summing of SENS switch settings with the meter indication results in a true value (except for noise-to-ground measurements) of the received level. See Section 2,Specifications, for range of measurements and the true value of noise-to-ground measurements.
S9	FILTER switch	Selects the receiver frequency response filter compatible with characteristics of the input signal to be measured. See figures 2–1 and 2–2 for filter response curves.
S11	BATT. TEST pb switch	When depressed, disconnects meter M1 from receiver output and connects the meter for testing the battery power source.
S12	POWER switch	In the BATT position, connects the 12 1.5V internal batteries to send circuits (via switch S13) and receive circuits. In the 48V position, connects jack J5 to the send and receive circuits. The OFF position removes all power.
S13	(See R101/S13)	
S14	SEND FREQ switch	Selects one of eight fixed send frequencies. In the EXT position, the send oscillator is connected to EXT FREQ connector J7.
S15	SEND LEVEL switch	Inserts a 10 dB loss in the output of the send circuitry.
S16	SEND IMP & TERM A switch	Selects send-circuit output impedance of 600 ohms or 900 ohms, and selects 600 ohms +2μF or 900 ohms +2μF quiet termination for connection to A jack J1 via switch S3.

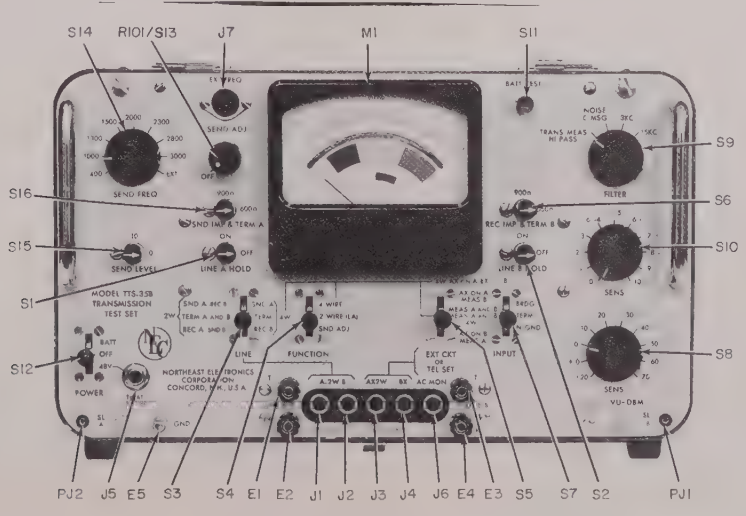

Figure 3–1. TTS 35B Front Panel Controls, Indicators and Connectors

3.3 GENERAL OPERATING CONSIDERATIONS.

3.4 The instrument may be powered from internal dry cell batteries or from the 48 volt office battery.

NOTE

The portable version of this instrument has been calibrated with the meter in the horizontal position, and the rack-mounted version with the meter in the vertical position. To obtain the specified accuracy, the instrument must be operated in the same position in which it was calibrated. To operate the instrument in another position, it must be recalibrated while the meter is in the desired position.

3.5 When the portable instrument's cover is closed, a projection inside the cover prevents the power switch from being left turned on. For this reason, and to protect the panel from damage, the cover should be closed when the instrument is not in use.

3.6 Whenever the POWER switch is set to apply power to the test set, the BATT TEST pushbutton should be depressed to establish the condition of the power source. When the internal batteries are employed as a power source, a meter indication in the green sector marked GOOD indicates satisfactory battery voltage. When an extensive series of tests is being made with other than new cells, make occasional checks of the internal battery voltage to insure continued satisfactory test results. When an external power source is used, an upscale meter indication (in the GOOD sector) verifies correct power supply polarity. The instrument will not be damaged by polarity reversals; however, it will be inoperative until the correct polarity is applied to the power input connector.

3.7 Prior to the application of power to the instrument, check that the meter's pointer is directly over the line at the extreme left of the meter's scale (mechanical meter zero). Refer to paragraph 5.4 for mechanical zeroing.

3.8 Except for the power supply cord, cords used with the test set should be 2-or 3-conductor cords for connection to the tip and ring conductors of the circuit. Each cord should have a 310-type plug on the end toward the test set. For connection to the send and receive branches of a 4-wire circuit, a 4-or 6-conductor cord having a 425-type plug on the end toward the test set may be used. The 425-type plug must be properly inserted into the jacks of the test set to put the send branch of the circuit on the LINE - SND 4W jack. The power supply cord for an external source of dc power should have a 310-type plug on the end toward the test set, but only the tip and sleeve conductors are used.

3.9 To avoid any affect on the receive circuitry when measuring noise or large losses, remove power from the send circuitry by turning the SEND ADJ control completely counterclockwise to OFF.

3.10 When a LINE (A or B) HOLD switch is set to the ON position, the circuit connection to the corresponding LINE jack will be held regardless of any other switch position.

3.11 In the following procedures the names of jacks, switches and other controls are given in abbrevaited form. For example, the LINE-A 2W SND - 4W jack will be referred to as the A jack.

3.12 OPERATION.

3.13 POWERING THE TEST SET.

3.14 Observe the following precautions during the application of the external power source to the test set:

NOTE

When using the TTS 35XPS AC Power Supply Adapter to power the TTS 35, do not turn on the TTS 35XPS unit until connected to the TTS 35 unit. Read instructions for the TTS 35XPS in Appendix 2 before using the unit.

a. Do not attach the external power source to the power cord until the cord has been connected to the test set.

b. The correct battery polarity for the power cord is negative on tip, positive on sleeve.

c. Disconnect the office battery from the power cord prior to removal of the cord from the test set.

3.15 The following procedure provides the powering instructions for the test set.

ACTION	RESULT
a. Internal battery operation: Set the POWER switch to BATT and depress the BATT TEST pushbutton.	Meter must indicate GOOD (green sector) or all dry cells must be replaced.
b. External 48V operation: Place tip-sleeve cord in the 48V jack first, then to power supply. Set the POWER switch to 48V and depress BATT TEST pushbutton.	Meter must indicate upscale or polarity is reversed at power source. Meter should indicate GOOD also.

3.16 TO HOLD A CIRCUIT WITH DC LOOP SUPERVISION AND DIAL ON IT.

ACTION	RESULT
a. Set the A HOLD or B HOLD switch to ON, corresponding to the LINE jack being used.	This seizes the circuit.
b. Patch A jack or B jack correspondingly to circuit when not busy.	
c. Patch the off hook subscriber set with a dial to the AX jack, tip and ring.	
d. Set the EXT CKT switch to AX ON A or AX ON B corresponding to the LINE jack being used.	
e. Set the A HOLD or B HOLD switch to OFF corresponding to the LINE jack being used.	Circuit is held by the off hook subscriber set.
f. Dial the required number.	
g. To hold a circuit without the telephone set, set the A HOLD or B HOLD switch to ON corresponding to the LINE jack being used.	

3.17 TO TALK ON A 2-WIRE CIRCUIT.

ACTION	RESULT
a. Set the A HOLD or B HOLD switch to ON corresponding to the LINE jack being used.	This seizes the circuit.
b. Patch A jack or B jack correspondingly to the circuit when not busy.	
c. Patch the off hook subscriber set to the AX jack, tip and ring.	The telephone set or circuit must supply the necessary dc talk battery.
d. Set the EXT CKT switch to AX ON A or AX ON B corresponding to the LINE jack being used.	The conditions are now ready for talking at the near end.

3.18 TO SEND ON A 2-WIRE CIRCUIT.

ACTION	RESULT
a. Apply power to the TTS 35 as instructed in paragraph 3.15.	
NOTE When using the TTS 35XV Continuously Variable Frequency Adapter to determine the send frequency, set the SEND FREQ switch to the EXT position in step b. below. Refer to Appendix 3 for operation fo the TTS 35XV, and for connection to the TTS 35B.	
b. Set the SEND FREQ switch at 1000 or specific desired frequency.	

ACTION	RESULT
NOTE The variation in output level due to the switching of frequency is less than 0.2 dB, thus permitting a change of frequency without a readjustment of the output level.	
c. Set FILTER switch at 15 KC.	
d. Set SND IMP switch at 600 or 900 ohm, according to the circuit impedance.	
e. Set REC IMP switch at 600 or 900 ohm, (Same as in step d).	
f. Set SEND LEVEL switch at 0.	
g. Set A HOLD switch at OFF.	
h. Set B HOLD switch at OFF.	
i. Set LINE switch at SND A.	
j. Set FUNCTION switch at SND ADJ.	
k. Set EXT CKT switch at MEAS A AND B.	
l. Set INPUT switch at TERM.	
m. Set SENS switches as follows:	
1. For 0 dBm, both SENS switches at black 0.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter. (See examples in Table 3–2).
2. For -10 dBm, both SENS switches at black 0.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter, then set SEND LEVEL switch to -10. (See examples in Table 3–2).
3. For other minus values (below 0 dBm), both SENS switches so sum of their minus values (black scale) equals desired whole number (–).	
If tenths are not involved.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter. (See examples in Table 3–2).
If tenths are involved.	Adjust SEND ADJ control to obatin required tenths of a dB from 0 dB on black scale of meter (See examples in Table 3–2.)
4. For plus values (above 0 dBm), both SENS switches so algebraic sum of their black scale values equals desired whole number (+).	
NOTE Some distortion is likely for sending levels above 0 dBm.	

ACTION	RESULT
If tenths are not involved.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter. (See examples in Table 3–2).
If tenths are involved.	Adjust SEND ADJ control to obtain required tenths of a dB from black 0 dB on meter. (See examples in Table 3-2).
n. Set FUNCTION switch at 2 WIRE (LA).	This completes preparation for sending.
o. Patch the A jack to circuit under test, tip and ring.	The set will send, at the chosen level and frequency, on the circuit under test.

Table 3–2. Examples of Switch Settings and Meter Indications for Desired Send Level

Desired Send Level	–70 to +20 SENS Switch	–10 to 0 SENS Switch	Algebraic Sum SENS Switches	SEND LEVEL Switch	SEND ADJ Adjusted Meter Indication
0	0	0	0	0	0
–10	0	0	0	–10*	0
–12.3	–10	–2	–12	0	–0.3
+2.5	+10	–8	+2	0	+0.5

* Set to –10 after adjusting SEND ADJ control for 0 dBm sending level.

3.19 TO MAKE 2-WIRE RECEIVING MEASUREMENTS.

ACTION	RESULT
a. Apply power to the TTS 35 as instructed in paragraph 3.15.	
b. Set SEND ADJ control at OFF, unless simultaneous sending is desirable.	
c. Set FILTER switch at desired position.	
d. Unless simultaneously sending, SND IMP switch position is immaterial.	
e. Set REC IMP switch at 600 ohms or 900 ohms, according to circuit impedance.	
f. Set LINE switch at SND A REC B.	
g. Set FUNCTION switch at 2 WIRE (LA).	
h. Set INPUT switch at TERM, unless bridging measurement (BRDG).	
i. Patch circuit to be measured to B jack.	
j. To dial or talk on circuit, EXT CKT switch to AX ON B.	
k. To make receiving measurement, EXT CKT switch to MEAS A AND B.	

ACTION	RESULT
l. When test power received on meter, adjust SENS rotary switches.	Obtain indication bewteen +3 dB and −3 dB on black scale, or near as possible to this range. Level measurement is algebraic sum of black scale readings on SENS switches and black scale meter indication. (See examples in Table 3−3.)

Table 3−3. Examples of Switch Settings and Meter Indications for Measuring Received Levels.

SENS Switches Sum Black Scales	Indication	Received Level in dBm
+10	+1	+11
+20	−2	+18
0	−1.4	−1.4

m. Telephone set or 600 ohm impedance receiving device may be connected to AC MON jack.	Negligible effect on meter reading.

3.20 LOOP AROUND MEASUREMENTS.

3.21 These measurements, made from one office only,obtain the loss in both directions of transmission on 2-wire, 2-way or 1-way outgoing from that office. In order to do this, two such circuits having the same nominal impedance are used. This involves special loop around equipment at the distant office, such as the Northeast Electronics Corporation Model TTS 50 equipment. By access to one test line code number at the distant office, a milliwatt of testing power will be sent automatically to the testing office. Then by holding that test line and reaching another access test line on the second circuit, the two circuits will be connected together at the distant office. Code numbers are assigned to the two access lines of this loop around equipment. They are referred to as Line 1 and Line 2. Figure 3−2 illustrates a typical arrangement of the loop around.

ACTION	RESULT
a. Turn on and adjust to desired sending frequency and level, as described in paragraph 3.18 steps a through o.	
b. Set FILTER switch to desired position.	
c. Set SND IMP switch at 600 ohm or 900 ohm according to circuit impedance.	
d. Set LINE switch at REC A SND B.	
e. Set FUNCTION switch at 2 WIRE (LA).	
f. Set EXT CKT switch at MEAS A AND B.	
g. Set INPUT switch at TERM.	
h. Seize circuit PQ (figure 3−2) and patch to A jack.	
i. On circuit PQ, call distant office Line 1 access code number.	At distant end, 1 MW applied automatically.

ACTION	RESULT
j. Measure received test power.	This gives loss from Q to P.
k. Set A HOLD switch at ON.	This holds circuit PQ at testing end.
l. Seize circuit RS and patch to B jack.	
m. On circuit RS, call distant office Line 2 access code number.	At distant end, circuits PQ and RS are connected together automatically. Set will send on circuit RS and receive on circuit PQ.
n. Measure received test power.	This gives loss from R to S + loss from Q to P.
o. Subtract loss obtained in step j, from loss obtained in step n.	This gives loss from R to S.
p. Set B HOLD switch at ON.	This holds circuit RS at testing end.
q. Set LINE switch at SND A REC B.	Set will send on circuit PQ and receive on circuit RS.
r. Measure received test power.	This gives loss from P to Q + loss from S to R.
s. Set A HOLD and B HOLD switches at OFF.	This releases circuits PQ and RS.
t. On circuit PQ, call distant office Line 1 access code number.	At distant end, 1 MW applied automatically.
u. Measure received test power.	This gives loss from S to R.
V. Substract loss obtained in step u from loss obtained in step r.	This gives loss from P to Q.

3.22 VU MEASUREMENTS.

3.23 Since the dynamic characteristics of the meter in the test set are identical to those of a VU meter, making VU measurements follows the same steps as those for the receiving measurements given in paragraph 3.19.

3.24 NOISE MEASUREMENTS.

ACTION	RESULT
a. Apply power to the TTS 35 as instructed in paragraph 3.15.	

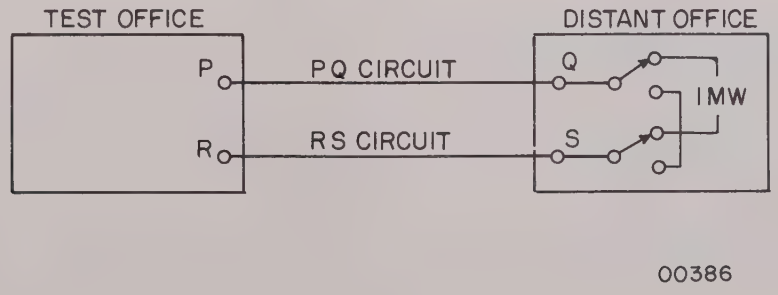

Figure 3–2. Typical Arrangement for Loop-Around Measurements.

ACTION	RESULT
b. Set SEND ADJ control at OFF.	This is important for 2-wire noise measurements, and essential for 4-wire measurements and dBrnC measurements.
c. Set FILTER switch at NOISE.	
d. Set SND IMP switch at 600 ohm or 900 ohm if 4-wire circuit, otherwise immaterial.	
e. Set REC IMP switch at 600 ohm or 900 ohm according to circuit impedance.	
f. Set LINE switch at SND A REC B for 2-wire circuit; at REC B for 4-wire.	
g. Set FUNCTION switch at 2 WIRE (LA) for 2-wire circuit; at 4 WIRE for 4-wire.	
h, Set EXT CKT switch at MEAS A AND B.	
i. Set INPUT switch at TERM for metallic noise; at N-GND for noise-to-ground.	
j. Patch 2-wire circuit to B jack. For 4-wire, patch transmitting branch to A jack; receiving branch to B jack. For noise-to-ground measurement, also connect ground to the GND binding post.	
k. Adjust both SENS switches.	Obtain indication on blue scale between 7 dBrn and 13 dBrn, or near as possible to this range. The noise measurement is the sum of the blue scale SENS switch settings and the blue scale meter indication. For noise-to-ground measurements, 40 dBrn must be added to this sum.
	NOTE When recording noise measurements, the type of filter should be included, e.g. 42 dBrnC (for C-message), 85 dBrn for 15 kHz (for flat).

3.25 LOCAL LOOP MEASUREMENTS SUCH AS REPEATER GAIN TESTS.

3.26 The test set may be used to send and receive simultaneously, which makes repeater gain tests or other local loop tests (2-wire) possible without use of another set.

ACTION	RESULT
a. Apply power to the TTS 35 as instructed in paragraph 3.15.	
b. Set SEND FREQ switch at 1000 or specific desired frequency.	
c. Set FILTER switch at desired position	

ACTION	RESULT
d. Set SND IMP switch at 600 ohm or 900 ohm according to circuit impedance.	
e. Set REC IMP switch at 600 ohm or 900 ohm (Same as in step d.).	
f. Set SEND LEVEL switch at 0.	
g. Set A HOLD switch at OFF.	
h. Set B HOLD switch at OFF.	
i. Set LINE switch at SND A REC B.	
j. Set FUNCTION switch at SND ADJ.	
k. Set EXT CKT switch at MEAS A AND B.	
l. Set INPUT switch at TERM.	
m. Set SENS switches as follows:	
1. For 0 dBm, set both SENS switches to black 0.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter.
2. For −10 dBm, set both SENS switches to black 0.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter, then set SEND LEVEL switch to −10.
3. For other minus values (below 0 dBm), set both SENS switches so sum of their minus values (black scale) equals the whole number nearest the desired value.	
If tenths are not involved in the desired value.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter.
If tenths are involved in the desired value.	Adjust SEND ADJ control to obtain required tenths of a dB from 0 dB on black scale of meter. (See examples in Table 3–2).
4. For plus values (above 0 dBm), set both switches so algebraic sum of their black scale values equals the whole number nearest the desired value.	
NOTE Some distortion is likely for sending levels above 0 dBm.	
If tenths are involved in the desired value.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter.
If tenths are involved in the desired value.	Adjust SEND ADJ control to obtain required tenths of a dB from black 0 dB on meter. (see examples in Table 3–2).
n. Set FUNCTION switch at 2 WIRE (LA).	This completes preparation for testing.

ACTION	RESULT
o. Patch output of loop circuit or repeater equipment to B jack.	
p. Patch input of loop circuit or repeater equipment to A jack.	Set now sending required frequency and level into circuit and measuring output from circuit.
q. Set SENS switches to obtain indication between +3 dB and −3 dB on meter, or near as possible to this range.	Gain or loss is algebraic sum of both SENS switch (black scale) settings, the meter indication, and sending level with its sign reversed. (See examples in Table 3–4).

Table 3–4. Examples of Summing to Determine Gain or Loss

Sending Level (A)	Meter Reading (B)	Algebraic Sum of Final SENS Switch Settings (C)	Algebraic Sum of (B) and (C) (D)	Sending Level With Sign Reversed (E)	Measurement Algebraic Sum of (D) and (E) (F)
0	−1.2	−5	−6.2	0	−6.2
0	−0.3	+7	+6.7	0	+6.7
−10	−0.4	−11	−11.4	+10	−1.4

3.27 USING THE TEST SET TO PROVIDE PRECISION TERMINATIONS

ACTION	RESULT
a. Set EXT CKT switch at MEAS A AND B.	
b. Set LINE key at TERM A AND B.	
c. For A jack, set SND IMP switch to desired position.	
d. For B jack, set REC IMP switch to desired position.	
e. Patch circuit to corresponding A or B jack.	Circuit now terminated by either 600 ohm +2μF or 900 ohm +2μF as designated.

3.28 4-WIRE CIRCUITS.

3.29 Talking and Monitoring. For this purpose the telephone set requires modification. The transmitter must be connected to the tip and ring of a cord having a 310 type plug on the end toward the test set, and this cord must be connected to the AX jack of the test set. The receiver must be connected to the tip and ring of a cord having a 310 type plug on the end toward the test set, and this cord must be connected to the BX jack of the test set.

ACTION	RESULT
a. Patch transmitting branch of circuit to A jack of set.	
b. Patch receiving branch of circuit to B jack of set.	

ACTION	RESULT
c. Connect transmitter cord of modified telephone set to AX jack of set.	
d. Connect receiver cord of modified telephone set to BX jack of set.	
e. Set EXT CKT switch to AX ON A-BX ON B position.	Transmitter is on transmitting branch, receiver is on receiving branch of circuit.
f. To monitor transmitting branch, interchange telephone set cords.	Transmitter is on receiving branch, receiver is on transmitting branch of circuit.

3.30 To Make 4-Wire Tests.

ACTION	RESULT
a. Apply power to the TTS 35 as instructed in paragraph 3.15.	
b. Set SEND FREQ switch at 1000 or specific desired frequnecy.	
c. Set FILTER switch at desired position.	
d. Set SND IMP switch at 600 ohm or 900 ohm according to circuit impedance.	
e. Set REC IMP switch at 600 ohm or 900 ohm according to circuit impedance.	
f. Set SEND LEVEL switch at 0.	
g. Set A HOLD switch at OFF.	
h. Set B HOLD switch at OFF.	
i. Set LINE switch at SND A.	
j. Set FUNCTION switch at SND ADJ	
k. Set EXT CKT switch at MEAS A AND B.	
l. Set INPUT switch at TERM.	
m. Set SENS switches as follows:	
1. For 0 dBm, set both SENS switches to 0 on the black scale .	Adjust SEND ADJ control to obtain 0 dB on black scale of meter.
2. For −10 dBm, set both SENS switches to 0 on the black scale.	Adjust SEND ADJ control to obtain 0 dB on black sclae of meter, then turn SEND LEVEL to −10.
3. For other minus values (below 0 dBm) set both SENS switches so sum of their minus values (black scale) equals the whole number nearest the desired value.	
If tenths are not involved in the desired value.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter.

ACTION	RESULT
If tenths are involved in the desired value.	Adjust SEND ADJ control to required tenths of a dB from 0 dB on the black scale of the meter. (See examples in Table 3–2).
4. For plus values (above 0 dBm) Set both SENS switches so the algebraic sum of their black scale readings equals the whole number nearest the desired value.	
If tenths are not involved in the desired value.	Adjust SEND ADJ control to obtain 0 dB on black scale of meter. (See examples in Table 3–2.)
If tenths are involved in the desired value.	Adjust SEND ADJ control to obtain required tenths of a dB from black 0 dB on meter. (See examples in Table 3–2.)

n. This completes calibration of the sending level.

o. Select appropriate steps:

1. For sending on transmitting branch, with receiving branch terminated:

   a. Set FUNCTION switch at 4 WIRE.

   b. Set LINE switch at SND A.

2. For measuring on receiving branch, with transmitting branch terminated:

   a. Set FUNCTION switch at 4 WIRE.

   b. Set LINE switch at 4W REC B.

3. For simultaneously sending on transmitting branch and measuring on receiving branch:

   a. Set FUNCTION switch at 2 WIRE (LA).

   b. Set LINE switch at SND A REC B.

p. Patch receiving branch of circuit to B jack.

q. Patch transmitting branch of circuit to A jack.

r. Set SENS switches to obtain indication between +3 dB and –3 dB on meter, or near as possible to this range.

Gain (+) or loss (–) is algebraic sum of both SENS switch (black scale) settings, the meter indication, and sending level with its sign reversed. See examples in Table 3–4.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 Circuit descriptions and diagrams in this section provide all necessary principles of operation for a thorough understanding of the TTS 35 electronics circuits. A block diagram level of discussion describes the overall function and relationship of major components and assemblies; the schematic diagram level describes details of the functions and relationships within the components and assemblies. The block diagram description starts at paragraph 4.3; the detailed description starts at paragraph 4.19.

4.3 OVERALL CIRCUIT DESCRIPTION.

4.4 COMMON CIRCUITS.

4.5 Figure 7—1 illustrates the components and assemblies to be discussed as common circuits. In general, these are the send/receive switching and the power supply circuit.

4.6 Send/Receive Switching. Electrical connections between the send and receive circuits and the front panel connectors are established by EXT CKT OR TEL SET switch S5, LINE switch S3, and FUNCTION switch S4. FUNCTION switch S4 sets up the TTS 35 for testing 2-wire or 4-wire circuits, EXT CKT OR TEL SET switch S5 and LINE switch S3 are positioned to accomodate any dialing and telephone equipment to be used on the circiuts under test, in accordance with the tests desired to be performed.

4.7 Output from the send circuit may be connected to the input of the receive circuit, through FUNCTION switch S4, to permit measurement of the send level by VU-DB meter M1 in the receive circuit.

4.8 Holding coils may be connected to Line A jack J1 and Line B jack J2 by LINE A HOLD switch S1 and LINE B HOLD switch S2, respectively.

4.9 Power Circuits. Internal or external battery voltage is applied to the send and receive circuits of the TTS 35 through POWER switch S12. The receive circuits are isolated from the power source by impedance buffer stage Q1, and the send circuits provide their own decoupling network for isolation from the power source. Both power sources may be tested by depressing BATT TEST switch S11 and observing VU-DB meter M1.

4.10 SEND CIRCUITS.

4.11 Figure 7—1 illustrates the components and assemblies to be discussed as send circuits. These are the oscillator circuit, the buffer amplifier circuit, and output circuits.

4.12 Oscillator Circuit. Switch S13 on SEND ADJ control R101 disconnects —18V from the oscillator circuit (and the buffer amplifier) to conserve battery power when the send circuits are not in use. The oscillator circuit consists of transistorized stages Q101 through Q103 for audio frequency generation, and SEND FREQ switch S14 for selection of fixed audio frequencies or variable frequencies controlled by accessory equipment connected to EXT FREQ connector J7.

4.13 Buffer Amplifier Circuit. The buffer amplifier circuit consists of transistorized stages Q104 and Q105 for amplification and impedance matching, and SEND ADJ potentiometer R101 for continuously variable adjustment of the audio send level to output circuits.

4.14 Output Circuits. Audio send levels are coupled through output transformer T2 to the send level and impedance matching network and switches. SEND LEVEL switch S15 connects send audio to FUNCTION switch S4, and selects 0 dB attenuation or —10 dB attenuation from the impedance network via SEND IMP & TERM A switch S16. Also output impedance of 600 ohms or 900 ohms from output transformer T2 is selected by SEND IMP & TERM A switch S16, and a third function of SEND IMP & TERM A switch S16 is to terminate line A (via LINE switch S3) with 600 ohms or 900 ohms to match the impedance of telephone circuits under test.

4.15 RECEIVE CIRCUITS.

4.16 The receive circuits consist of input circuits, three amplifier circuits, and an emitter follower tone monitoring circuit as illustrated in figure 7—1.

4.17 Input Circuits. Receive levels from FUNCTION switch S4 are coupled through input transformer T1 and the impedance matching network and switches. Input impedance of 600 ohms or 900 ohms for transformer T1 and the Line B quiet termination are selected by REC IMP & TERM B switch S6, and the output of transformer T1 is connected through switch S6 and INPUT switch S7 to SENS switch S8 in the amplifier circuits. Also switch S7 is used to connect the receive circuits to a noise ground, or to substitute a bridgeimpedance for the usual 600/900 ohms at the input of T1.

4.18 Amplifier Circuits. Sensitivity (SENS) switches S8 and S10 select predetermined attenuation levels to keep received signals within the measuring capabilities of the three amplifier circuits and VU-DB meter M1. Amplifier 1 amplifies the signal level from SENS switch S8 and provides impedance matching into the filter networks associated with FILTER switch S9. Four different filter networks may be selected by the FILTER switch to provide desired frequency response curves. Amplifier 2 provides isolation between the sensitivity and filter circuits and final amplifier 3. A detector circuit at the output of amplifier 3 converts received signals into average values of direct current for display on VU-DB meter M1. The tone monitor amplifier,emitter follower circuit Q303, permits audible monitoring of received signals at AC MON jack J6.

4.19 DETAILED CIRCUIT DESCRIPTION.

4.20 RECEIVE SECTION.

4.21 The gain of the receive section is obtained from three

amplifiers. Each amplifier is enclosed with a large amount of negative feedback to insure gain stability. The inherent noise level of the unit is at least −100 dBm and approaches −120 dBm when the C-message filter is used. The receive section is divided into the following subject headings for discussion purposes: Input Circuit, 10 dB Step Attenuation,Amplifier 1, Filter Switching Network, 1 dB Step Attenuation, Amplifier 2, Amplifier 3, Metering Circuit, Tone Monitoring Circuit, and Power Circuit.

4.22 Input Circuit. Refer to figures 7−2 and 7−3. The input line connections are made via switches S3 through S4 to a balanced transformer (T1) with dc blocking capable of withstanding 150 volts dc of either polarity. Terminating resistors for 600 ohm and 900 ohm input impedances can be switched directly across the input line while maintaniing the dc blocking. These terminating resistors are switched at the equal potential (center-tapped point) to maintain a balance of at least 80 dB at 60 Hz and 70 dB at 1000 Hz, and a balance better than 60 dB up to 10 kHz. A longitudinal drain, with center tap connected to ground through a resistor, is included. Transformer T1 has a 1:1 ratio. Since the secondary of T1 is loaded by a high impedance, the primary of the transformer also looks like a high impedance. This reflected impedance is seen in the bridging position of INPUT switch S7, and is nominally 12,000 ohms for 600 ohm circuits and 15,000 ohms for 900 ohm circuits. The bridginglosses are less than ±0.2 dB for frequencies down to approximately 100 Hz. One section of switch S6 is used to select a quiet termination for Line B jack J2.

4.23 10 dB Step Attenuation. Refer to figure 7−4. SENS switch S8, a three section attenuator, provides sensitivity adjustments in 10 dB step. In one section, 30 dB is available in 10 dB steps from a tapped voltage divider. Two other sections, each having 30 dB loss, can be switched ahead of the 10 dB divider. For the first 30 dB of loss, only the tapped voltage divider is used. For 40 dB of loss, which corresponds to the −30 dB position of SENS switch S8, a single 30 dB section is placed ahead of the tapped voltage divider, and 10 dB of loss is brought into the output section. Thus, the tapped divider is used for the 10 dB steps, and the other two sections are brought in as necessary to extend the range of these 10 dB steps. To assure an attenuating accuracy of ±0.15 dB, 1% resistor tolerances are used in the attenuator network.

4.24 Amplifier 1. Refer to figure 7−5. Amplifier 1 is a two stage voltage amplifier with negative feedback. An emitter follower is incorporated in the output stage for impedance matching, since this amplifier drives the filter sections. Transistor stages Q102,Q103 and Q104 comprise amplifier 1. Transistor Q102 is a conventional common emitter with bias obtained from the collector for dc stabilization. Transistor Q103 is also operated in the common emitter, but since this is an NPN device, bias conditions and polarities are reversed. Transistor Q104 operates as an emitter follower to isolate the filter impedances from the collector of Q103 to which it is dc connected. The emitter current of Q104, both ac and dc is eventually returned to resistor R106, which is common to the emitter of Q102; this comprises negative feedback. For the circuit shown, approximately 30 dB of feedback is achieved and is effective over the entire band of frequencies. The two diodes in the emitter of Q104 are a battery compensating network. If the battery voltage decreases, the emitter current of Q104 will also decrease. This raises the impedance of these two diodes, decreases the negative feedback by a slight amount, and keeps the overall gain of the set relatively independent of battery voltage. The emitter of Q104 supplies an output through a resistor-capacitor network, which blocks dc and voltage switching transients from subsequent stages. The nominal output impedance of amplifier 1 is in the order of 5 ohms, due to its emitter follow type output and heavy amounts of feedback. Series resistor R110 is used to bring this impedance up to a value to match the characteristic filter impedance, which is 600 ohms.

4.25 Filter Switching Network. Refer to figure 7−6. The receive filter switching network consists of a 7-pole, 4-position rotary switch and associated resistors, capacitors, and inductors. The switching is divided into four representative filters, as illustrated in figure 7−6. For filter characteristics, refer to the specifications in Section 2 and to figures 2−1 and 2−2.

4.26 1 dB Step Attenuation. Refer to figure 7−7. SENS switch S10 is a conventional stepped voltage divider which presents a 600 ohm impedance to the filter and is terminated by the high impedance of Amplifier 2. To assure an attenuating accuracy of ±0.15 dB, 1% resistor tolerances are used in this attenuator network, which provides a 10 dB range of attenuation in 1 dB increments.

4.27 Amplifier 2. Refer to figure 7−8. Amplifier 2 is a three stage amplifier consisting of Q201,Q202, and Q203. Negative feedback is applied from the emitter of Q203 to the emitter of Q201, and the output to Amplifier 3 is taken from the collector of Q203. Transistor Q201 is a conventional common emitter amplifier with collector to base bias. Transistor Q202 is alos a common emitter configuration, but since this is an NPN transistor the emitter is returned to battery while the collector is returned to ground. The output of Q202 at the collector is direct coupled to the base of Q203, which is also of the common emitter configuration. The emitter of Q203 contains a large amount of dc resistance to give the proper amount of current with its base connected to the collector of Q202. Most of this resistance is bypassed by capacitor C203 so that degeneration at signal frequencies will not occur in this stage. The unbypassed part of the emitter resistance is resistor R209, which provides overall loop feedback to stabilize the gain of Amplifier 2.

4.28 Amplifier 3. Refer to figure 7−9. Amplifier 3 consists of Q301 and Q302 and a full-wave diode bridge detector circuit. Both transistor stages are operated as common emitters, with bias derived from the collector for dc stabllization. The output of Q302 is applied to the diode bridge, which is returned to the emitter of Q301 to supply negative feedback. When the signal at the collector of Q302 is a negative half cycle, CR302 will not conduct and CR301 will conduct. The signal cannot pass through CR303; therefore it must go through the meter and through CR304 back to the emitter of Q301. When the collector of Q302 goes positive, similar reasoning will show thatthe path of conduction will be through CR302, the meter, CR303, and back to the emitter of Q301. The ballistics of the meter will ignore the peaks and respond to the average value of dc. The meter is calibrated so that this average value is

indicated in rms value. The characteristics of such a circuit linearize the resistances of the diodes. For instance, as the resistance of the diodes increases due to temperature change or decreased meter current, the feedback is automatically adjusted so that the meter current is a linear function of the input voltage. This is true for wide ranges of temperature and for greatly mismatched diodes; thus the circuit is relatively uncritical either to component values or diode voltage/current relationships. Potentiometer R308 provides gain adjustment for amplifier 3.

4.29 Metering Circuit. Refer to figure 7–10. Meter M1 is used for battery testing, as well as for measuring the level of signals received from amplifier 3 and the detector circuit described in paragraph 4.28. To check battery condition, BATT TEST switch S11, when depressed, disconnects the meter from amplifier 3, and connects battery voltage through multiplier resistor R13 to the meter. A green arc marked GOOD is provided on the face of the meter to indicate internal battery condition.

4.30 Tone Monitoring Circuit. Refer to figure 7–9. The tone monitor consists of Q303, which samples part of the signal available in Amplifier 3, amplifies it, and provides a given source of impedance available to AC MON jack J6. The signal this amplifier samples at the emitter of Q301 in amplifier 3 is a sine wave and a direct function of received signal. The input impedance of monitor amplifier Q303 is high and does not materially influence the amount of feedback or the value of the gain of either Amplifier 3 or the entire set. To conserve internal battery power, the collector voltage for Q303 is disconnected until a plug is inserted into the AC MON jack. The signal available at the AC MON jack is dc blocked so that a dc resistance can be inserted between the tip and ground of the jack. This dc blocking is provided by electrolytic capacitor C306, which means that any dc voltage applied to the tip of the AC MON jack should not exceed 9 volts negative or 12 volts positive. The frequency response of the monitoring circuit is –3 dB at 100 Hz and 15 kHz for the flat 15 KC position of FILTER switch S9. For other filter positions, the response at the monitor jack is identical with the response to the meter. Signal to noise output at this jack is greater than 30 dB for meter readings of at least –3 dBm. The output level is –10 dBm when the meter reads 0 dB.

4.31 Power Circuit. Refer to figure 7–10. A high gain amplifier capable of responding to very low frequencies (down to 1.0 Hz) would require extremely large values of capacitance for conventional RC decoupling between the amplifier and its power supply. Consequently, receive amplifiers 1 and 2 are decoupled from the battery supply by transistor Q1 and associated circuitry. Transistor Q1 is an emitter follower operating as a series device, with sufficient base bias to insure saturation and very little collector to emitter voltage drop. The base of Q1 is held relatively fixed by capacitor C2, and the emitter must follow the base. The effect of such a circuit is the same as a conventional RC decoupling network, except that the RC product is effectively increased by the beta of the transistor. In other words, the same amount of decoupling is obtained with 100 μF as with 5000 μF in conventional RC decoupling. Amplifier 3 is supplied through conventional RC decoupling, the chief function of which is to keep the battery impedance relatively constant. This insures that local feedback which could be introduced by an ageing battery will not seriously affect the low-frequency response. When a plug with 48 volts of the proper polarity is inserted in the 48 volt jack and POWER switch S12 is set to 48V, CR1 will conduct. Zener diode CR2 will conduct in the reverse direction and maintain a constant voltage. Resistor R10 limits the amount of current through the zener diode to a proper value.The use of the zener and the series transistor filter produces sufficient filtering to insure the proper signal to noise ratio, provided that noise from a station battery does not exceed 1 volt peak to peak at 10 Hz or higher. Fuse F1 protects against inadvertent connection to excessive external voltage. Battery test resistor R13 is connected to the meter (when S11 is depressed) from the primary point of power application, whether from internal or external batteries. Note that battery test can occur only when the power switch is on and the batteries are operating under a load.

4.32 SEND SECTION.

4.33 A stable oscillator and front panel controls provide a continuously variable output level (+3 dBm to –40 dBm) for eight different frequencies at an impedance of 600 ohms or 900 ohms. For discussion purposes, the send section is divided into the following circuits: Oscillator Circuit, Buffer Amplifier Circuit, Output Circuit and Power Circuit.

4.34 Oscillator Circuit. Refer to figure 7–11. The bridged-T oscillator uses the PNP transistor stages. The first two stages, Q101 and Q102, are direct-coupled between the collector of Q101 and the base of Q202. A positive feedback path is provided from the emitter of Q102 through tungsten bulb TR101, potentiometer R102, and emitter resistor R153 to the emitter of Q101. Potentiometer R102 permits factory adjustment of the positive feedback necessary for stable operation. Negative feedback is normally greater than the positive feedback and is supplied to the base of Q101 through a selective null network and emitter follower Q103. The selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation at the selected frequency. For the fixed, internally selected frequencies, the frequency determining network consists of capacitors C152 and C153, selected capacitors C154 and C155, and two resistors selected by SEND FREQ switch S14. For externally selected frequencies, capacitors C152 through C155 and circuitry provided in the TTS 35XV cover accessory determine the oscillator frequency.

4.35 Buffer Amplifier Circuit. Refer to figure 7–11. The buffer amplifier circuit is comprised of one stage of voltage amplification (Q104) and one stage of impedance matching (Q105). The oscillator signal voltage developed at the emitter of Q102 is connected to the base of Q104 through SEND ADJ control R101, which is located on the front panel to permit adjustment of output level from +3 dB to –40 dB. The send output is taken from the emitter of Q105 and coupled to the primary of output transformer T2 through capacitor C160.

4.36 Output Circuit. Refer to figure 7–11. The secondary of output transformer T2 is ac coupled by capacitor C161 to FUNCTION switch S4, shown in figure 7–2. SEND LEVEL switch S15 inserts or removes a fixed –10 dB pad into the oscillator output. SND IMP & TERM A switch S16 selects

the proper resistive values for an output impedance of 600 ohm or 900 ohm, and selects the proper values for the −10 dB pad to match the selected output impedance. One section of switch S16 is used to select a quiet termination, shown in figure 7−2, for LINE A jack J1.

4.37 Power Circuit. Refer to figures 7−10 and 7−11.

The oscillator and buffer amplifier (send) circuits are powered through switch S13, part of the SEND ADJ control on the front panel, when POWER switch S12 is in the BATT position. In the 48V position of switch S12, external battery power is connected through a zener diode regulating circuit (CR2 and R19) via contacts S12-5 and 6 before being applied to switch S13. Decoupling is provided by 47 ohm resistor R159 and 100μF capacitor C158 shown in figure 7−11.

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 INTRODUCTION.

5.2 Procedures for maintenance and calibration are provided in this section. Necessary test equipment is listed and described. Calibration should not be attempted by personnel who are not familiar with the purpose and operation of the test set.

5.3 METER ZERO ADJUSTMENT.

5.4 Zero adjustment of the meter is made by adjusting the screw on the bottom-front of the meter case until the indicating needle is directly over the last scale mark on the left. On portable models, the adjustment should be made with the meter in the position in which it will be operated, i.e., vertical or horizontal.

5.5 BATTERY REPLACEMENT.

5.6 When the meter indicates below the GOOD arc with POWER switch S12 set to BATT and BATT TEST switch S11 depressed, replace the 12 D size batteries as follows:

a. Remove the attaching screws from the rear cover of the case.

b. Remove retaining clips that secure the batteries.

c. Observing polarities marked on the cell holders, install fresh 1.5 volt D cells.

d. Test batteries by setting POWER switch S12 to BATT, depressing BATT TEST switch S11, and observing the indication on VU-DB meter M1.

e. Install the battery retaining clips and the rear cover.

5.7 TEST EQUIPMENT REQUIRED.

5.8 The following is a list of test equipment required for maintenance and calibration of the TTS 35B/BR.

a. Oscilloscope with a minimum sensitivity of 100 mv/cm at 100 kHz.

b. Voltmeter with a minimum input resistance of 20,000 ohms/volt dc.

c. Signal Source with an output impedance of 600 or 900 ohms, capable of developing an output signal of 1 mw into 600 or 900 ohms at a frequency of 1 kHz. The tolerance of the output level must be ±0.1 dB.

5.9 CALIBRATION.

5.10 Before assuming that the TTS 35 receive section requires calibration, check the batteries, front panel control settings, input signal connections, and the condition of cords and jacks used for patching the circuit under test. If the above checks are satisfactory, check the calibration of the receive section as follows:

a. Using the signal source described in paragraph 5.8 c., set up the TTS 35 for receiving measurements as described in paragraph 3.19, steps a through l., except set FILTER switch S9 to 15 KC. BLACK FOR 35 BAQ

b. Adjust signal source for an output of 1 mw at 1 kHz.

c. Set SENS switches S8 and S10 to 0 (black numbers).

NOTE

The TTS 35 must be calibrated in the same position in which it will be operated, i.e., vertical or horizontal.

d. If VU-DB meter M1 indicates 0 ±0.1 dB (black scale), the TTS 35 receive circuits are correctly calibrated.

e. If the indication in step d. above is incorrect, remove the TTS 35 from the case.

f. Repeat steps a through c above,

g. Adjust potentiometer R308 in Amplifier 3 so that VU-DB meter M1 indicates 0 (black scale).

FOR BLUE ADDITION ADJUST POT BEHIND METER ON 35 BAQ

5.11 TROUBLESHOOTING.

5.12 By using the test equipment described in paragraph 5.8, the voltage values shown on the schematic daigrams, and the operating procedures in section 3, a qualified technician should have no difficulty in troubleshooting the TTS 35.

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION.

6.2 This section contains a complete listing of electronic parts in the TTS 35B/BR. Parts list Tables 6–2 through Table 6–11 are arranged alpha-numerically by reference designation. Table 6–1 is a listing of Federal Supply Code of Manufacturers (FSCM) for replaceable parts. Component Location digarams, Figures 6–1 through 6–5 are included to facilitate maintenance.

Table 6–1. List of Manufacturers

Code	Manufacturer
01121	Allen Bradley Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Dallas, Texas 57231
04713	Motorola Inc. Pheonix, Arz. 85008
09653	IEI Brooklyn, N.Y.
12065	Transitron Electronic Corp. Boston, Mass. 02128
12697	Clarostat Mfg. Dover, N.H. 03820
12954	Dickson Electronics Corp. Scottsdale, Ariz. 85252
13606	Sprague Electric Co. Transistor Div. Concord, N.H. 03301
19701	Electra/Midlands Mineral Wells, Texas 76067
25712	Esse Co. Chicago, Ill. 60629
27735	F-DYNE Electric Co. 06430
49671	RCA Corp. N. Y. , N.Y. 10020
49956	Raytheon Co. Lexington, Mass. 02173
71590	Centralab Milwaukee, Wis. 53201
71785	Cinch Mfg., Co. Chicago, Ill. 60624
72136	Electro Motive Mfg. Willimantic, Conn. 06226
75915	Littelfuse Inc. Des Planes, Ill. 60016
76854	Oak MFg. Co. Crystal Lake, Ill. 60014
78957	Stromberg – Carlson Corp. Charlotsville, Va. 22902
80223	United Transformer Co. N. Y., N. Y. 10013
81073	Grayhill, Inc. La Grange, Ill. 60525
81095	Triad Transformer Corp. Venice, Calif. 90293
82389	Switchcraft Inc. Chicago, Ill. 60630
83330	Smith, Herman H. Brooklyn, N.Y. 11207
86632	Newton Engineering, Newton, Mass. 02161
94322	Tellabs Inc. Manchester, N.H. 03102

Table 6–2. TTS 35B/BR Overall Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
BP1	BINDING POST-RED	81073	29-1R	652400400
BP2	BINDING POST-BLK	81073	29-1B	652400300
BP3	SAME AS BP1			
BP4	SAME AS BP2			
BP5	TEST JACK,BLK	49956	TJ105BL.	650600100
BP6	SAME AS BP5			
BP7	BINDING POST METAL GND	83330	137SP	652500100
C3	100MF 00 150V	13606	TVA1420	300401071
C3B	SAME AS C3			
C101	50MF 00 75V	13606	D27359	301305062
CB1	CB-1 E-95908			A003520006
CR1	3 400V	12065	IN4004	560040040
CR2	CASE-59 1W 10% 18V	04713	1N4746	562004746
E1	20% 90V	SIEMENS	B1-C90/20	566009020
E2	SAME AS E1			
F1	.3A 00 250V	75915	3AG	863100200
J1	SPECIAL 00	82389	5J-1329	650401300
J2	SAME AS J1			
J3	SAME AS J1			
J4	SPECIAL 00	82389	5J-1192	650401000
J5	JACK,TEL,SWCRFT SCHEM 4	82389	12B	650101000
J6	SPECIAL 00	82389	5J-1191	650400900
L1	4H 00	86632	TN-1274	450200200
L2	SAME AS L1			
M1	1MA 2%	06555	2121	900100300
P1	5-PIN FEM RECEPT-PANEL	82389	61GA5F	652300200
P2	MOTOR MT 6 PIN FEM	02660	1-480270-0	650800200
P101	5K 2W 10%	12697	CM38414	230805023
PC1	AMP 1 E-95030 PC BD			A003520004
PC2	AMP 2 E-95031 PC BD			A003520005
PC3	E95155 OSC BD ASSY			A003520027
R8	4530- 1/8W 1%	19701	MF5C	220245311
R14	560- 3W 5%	13606	242E6815	210306815
S1 S2	300W 00	82389	11206L	640100100
S2	S3,S4,CR2 ASSY			A003520014
S3	SAME AS S2			
S4	SAME AS S2			
S5	4C-4C CONTACT	78957	173P	630100700
S6	300W 00	82389	11212L	640100500
S7	SAME AS S5			
S8	S-8			A003520021

Table 6–2. TTS 35B/BR Overall Assembly Parts List (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
S9	S-9			A003520019
S10	S-10			A003520020
S11	250MA 00 115V	81073	46-200R	635500100
S12	20-20 CONTACT	78957	173N	630100600
S14	S-14			A003520011
S15	SAME AS S1			
S16	SAME AS S6			
T1	P50 TO 600 S50K SPLIT	80223	A-20	400200100
TP1	TIEPOINT,SINGLE	71785	51	836400100
XF1	FUSEHOLDER 3AG CHASSIS	75915	357001	863000200

Table 6–3. TTS 35B/BR Input Impedance Circuit Board 1 Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R1	42.2- 1/8W 1%	19701	MF5C	220242291
R2	SAME AS R1			
R3	475- 1/8W 1%	19701	MF5C	220247501
R4	SAME AS R3			
R5	316- 1/8W 1%	19701	MF5C	220231601
R6	SAME AS R5			
R7				220610821
R9	37.449K 1/2W 1%	19701	MF7C	220687421

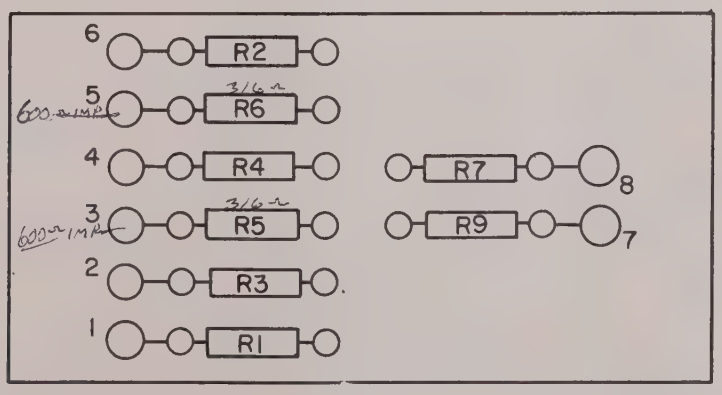

Figure 6–1. TTS 35B/BR Input Impedance Circuit Board 1 Component Location

Table 6–4. TTS 35B/BR Quiet Termination Circuit Board 2 Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C4				320202050
C5	SAME AS C4			
R15				220206011
R16				220203011
R17	SAME AS R16			
R18	SAME AS R16			

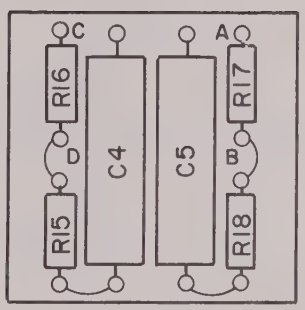

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Figure 6–2. TTS 35B/BR Quiet Termination Circuit Board 2 Component Location

Table 6–5. TTS 35B/BR Sensitivity Switch S8 and Resistor Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R601	1.02K 1/8w .5%	19701	MF5C	220310217
R602	3.24K 1/8W .5%	19701	MF5C	220332417
R603	10K 1/8w .5%	19701	MF5C	220310027
R604	475- 1/8W .5%	19701	MF5C	220347507
R605	14.134K 1/8w .5%	19701	MF5C	220314127
R606	1.4134K 1/8w .5%	19701	MF5C	220314117
R607	SAME AS R604			
R608	SAME AS R604			
R609	31.6K 1/8W 1%	19701	MF5C	220231621
R610	5.62K 1/8w .5%	19701	MF5C	220356217
S8	1A 00 28V	76854	269426-F6	625801000

Table 6–6. TTS 35B/BR Receive Amplifier 1 and Filter Circuit Board PC1 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C101	20MF		00	25V	09653	APD046	300902060
C102	560PF		1%	500V	72136	CM20D561F	335105610
C103							300901060
C104	.25MF		10%	80V	13606	192P2549R8	321102540
C105	SAME AS C101						
C401	1MF		20%	25	13606	5C023105X0250B3	330501050
C402	.2MF		10%	80V	13606	192P2049R8	321102040
C403	SAME AS C402						
C404	.15MF		10%	80V	13606	192P1549R8	321101540
C405	SAME AS C104						
C406	SAME AS C402						
C407	1.5MF		20%	200V	27735	TYPE D	320601550
C408							321105040
CR101	A21	80MW	00	80V	12065	1N198	561001980
CR102	SAME AS CR101						
L401	30MH	95MA	2%		81095	EC-030	460100400
L402	SAME AS L401						
L403	150MH	56MA	2%		81095	ET-150	460100600
L404	250MH	95MA	2%		81095	EC-250	460100500
Q102	TO5AFC	250MW	00	25V	01295	2N1374	553013740
Q103	TO5HNS	1W	00	65V	49671	2N2102	550021020
Q104	SAME AS Q102						
R104	820-	1/2W	10%		01121	TYPE EB	200208216
R105	3.9K	1/2W	5%		01121	TYPE EB	200203925
R106							220604701
R107	SAME AS R105						
R108	560K	1/2W	10%		01121	TYPE EB	200205646
R109							220601521
R110							220606211
R111	10K	1/2W	10%		01121	TYPE EB	200201036
R401							220606811
R403	SAME AS R110						
R410	183.7-	1/2W	1%		19701	MF7C	220618301

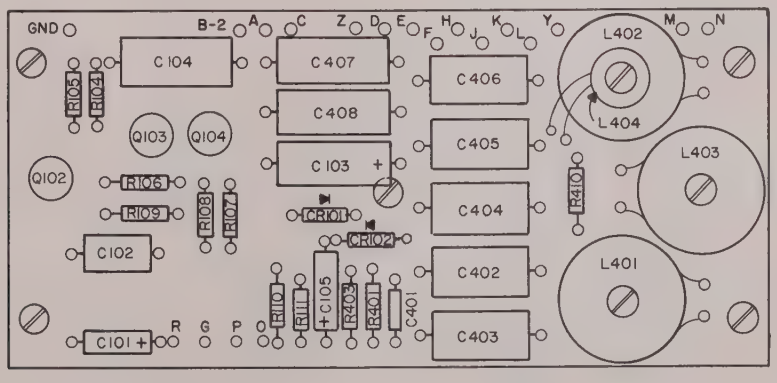

Figure 6–3. TTS 35B/BR Receive Amplifier 1 and Filter Circuit Board PC1 Component Location

Table 6–7. TTS 35B/BR Filter Switch S9 and Capacitor/Resistor Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION			MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C409	.0068MF		10% 100V	13606	225P68291WB3	320006820
C410	SAME AS C409					
C411	SAME AS C409					
C412	SAME AS C409					
C413	.04MF		10% 100V	13606	225P40391WB3	320004030
C414	SAME AS C413					
R402						220201821
R404	12.7K	1/8W	1%	19701	MF5C	220212721
R405	620-	1/8W	1%	19701	MF5C	220262001
R406	SAME AS R405					
R407	562-	1/8W	1%	19701	MF5C	220256201
R408						220201221
R409	SAME AS R408					

Table 6–8. TTS 35B/BR Sensitivity Switch S10 and Resistor Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION			MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R501	66.5-	1/8W	1%	19701	MF5C	220266591
R502						220205901
R503	52.3-	1/8W	1%	19701	MF5C	220252391
R504	40.4-	1/8W	1%	19701	MF5C	220246491
R505	41.2-	1/8W	1%	19701	MF5C	220241291
R506	36.5-	1/8W	1%	19701	MF5C	220236591
R507	33.2-	1/8W	1%	19701	MF5C	220233291
R508	29.4-	1/8W	1%	19701	MF5C	220229491
R509	26.1-	1/8W	1%	19701	MF5C	220226191
R510	22.6-	1/8W	1%	19701	MF5C	220222691
R511	187-	1/8W	1%	19701	MF5C	220218701
S10		1A	00 28V	76854	269478-J2C	626200100

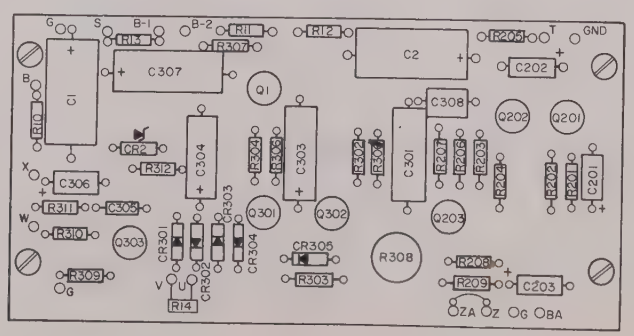

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Figure 6–4. TTS 35B/BR Receive Amplifiers 2 and 3 Circuit Board PC2 Component Location

Table 6–9. TTS 35B/BR Receive Amplifiers 2 and 3 Circuit Board PC2 Parts List

REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	100MF		00	50V	09653	APD127	300901072
C2	SAME AS C1						
C201	20MF		00	25V	09653	APD046	300902060
C202	2MF		00	15V	13606	TE1149	300202050
C203	5MF		00	15V	13606	TE1152	300205050
C301	.50MF		10%	75V	13606	225P5049R75Z83	320005040
C302	A21	80MW	00	80V	12065	1N198	561001980
C303							300910060
C304	100MF		00	20V	09653	APD095	300901071
C305	.1MF		30%	75V	71590	DDA-104	330201040
C306	SAME AS C201						
C307	SAME AS C1						
C308	1000PF		5%	500V	72136	CM20-E102J	335101021
CR2	A31A	1W	5%	24V	12954	1N3029B	562030297
Q1	TO5AFC	250MW	00	45V	01295	2N1375	553013750
Q201	TO9VAC	150MW	00	25V	01295	2N1748A	553017481
Q202	TO5HNS	1W	00	65V	49671	2N2102	550021020
Q203	TO5AFC	250MW	00	25V	01295	2N1374	553013740
Q301	SAME AS Q203						
Q302	SAME AS Q203						
Q303	SAME AS Q203						
R10							210304715
R11	10K	1/2W	10%		01121	TYPE EB	200201036
R12	43K	1/2W	5%		01121	TYPE EB	200204335
R13	27K	1/2W	10%		01121	TYPE EB	200202736
R14	1000#	125MW	1%		94322	CR16	211110011
R201	220K	1/2W	10%		01121	TYPE EB	200202246
R202							220603921
R203	560K	1/2W	10%		01121	TYPE EB	200205646
R204	390-	1/2W	10%		01121	TYPE EB	200203916
R205	100K	1/2W	10%		01121	TYPE EB	200201046
R206	3.9K	1/2W	5%		01121	TYPE EB	200203925
R207	4.7K	1/8W	1%		19701	MF5C	220247011
R208	4.3K	1/2W	5%		01121	TYPE EB	200204325
R209							220601501
R301	SAME AS R201						
R302	SAME AS R206						
R303	110-	1/8W	1%		19701	MF5C	220211001
R304	2K	1/2W	5%		01121	TYPE EB	200202025
R306	68K	1/2W	5%		01121	TYPE EB	200206835
R307	560-	1/2W	10%		01121	TYPE EB	200205616
R308	100#	3W	20%		25712	2204	230401010
R309	200-	1/2W	5%		01121	TYPE EB	200202015
R310	680-	1/2W	5%		01121	TYPE EB	200206815
R311	200K	1/2W	5%		01121	TYPE EB	200202045
R312	SAME AS R11						

Table 6–10. TTS 35B/BR Oscillator, Buffer Amplifier and Output Impedance Circuit Board PC3 Parts List

REFERENCE DESIGNATOR	DESCRIPTION		MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C150					300910060
C151	20MF	00 25V	09653	APD046	300902060
C152					320309620
C153	SAME AS C152				
C154	EL.VAL.	5% 500V	72136	CM15-	335000000
C155	SAME AS C154				
C156	SAME AS C151				
C157	SAME AS C151				
C158	SAME AS C150				
C159	SAME AS C151				
C160	50MF	00 15V	13606	TE1160	300205060
R102	500#	.5W 20%	71590	2EKATK001A85	231205011
Q101	T05AFC	250MW 00 45V	01295	2N1375	553013750
Q102	SAME AS Q101				
Q103	SAME AS Q101				
Q104	SAME AS Q101				
Q105	SAME AS Q101				
R150					200206836
R151	10K	1/2W 5%	01121	TYPE EB	200201035
R152	3K	1/2W 5%	01121	TYPE EB	200203025
R153	200-	1/2W 5%	01121	TYPE EB	200202015
R154	1K	1/2W 10%	01121	TYPE EB	200201026
R155	100K	1/2W 10%	01121	TYPE EB	200201046
R156	SAME AS R155				
R157	SAME AS R151				
R159					200204705
R160	62-	1/2W 5%	01121	TYPE EB	200206205
R161	68K	1/2W 5%	01121	TYPE EB	200206835
R162	SAME AS R151				
R163	2K	1/2W 5%	01121	TYPE EB	200202025
R164	820-	1/2W 10%	01121	TYPE EB	200208216
R165	2.2K	1/2W 5%	01121	TYPE EB	200202225
R166	1150-	1/8W 1%	19701	MF5C	220211511
R167	853.81-	1/8W 1%	19701	MF5C	220285301
R168	SAME AS R166				
R169	1.7337K	1/8W 1%	19701	MF5C	220217311
R170	1.28K	1/8W 1%	19701	MF5C	220212811
R171	SAME AS R169				
R172	294.2-	1/2W 1%	19701	MF7C → CPN 220229401	~~220629~~401
R173	485Ω	1/8W 1%			~~220648501~~ – 220648501
T2	P600CT S600SPL AUDIO PC		80223	SO-15P	400300200

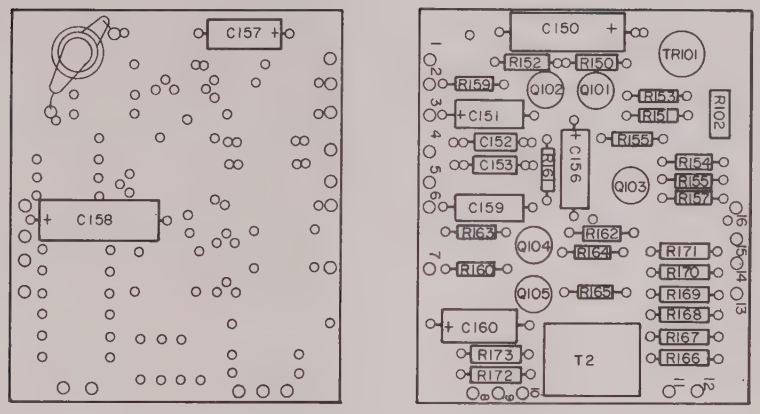

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Figure 6–5. TTS 35B/BR Oscillator, Buffer Amplifier and Output Impedance Circuit Board PC3 Component Location

Table 6–11. TTS 35B/BR Send Frequency Switch S14 and Resistor Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION		MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R101					220314527
R102	9.637K	1/8W .5%	19701	MF5C	220396317
R103	57.39K	1/8W .5%	19701	MF5C	220357327
R104					220303827
R105	45.61K	1/8W .5%	19701	MF5C	220345627
R106	2.923K	1/8W .5%	19701	MF5C	220329217
R107	40.14K	1/8W .5%	19701	MF5C	220340127
R108	2.538K	1/8W .5%	19701	MF5C	220325317
R109	30.75K	1/8W .5%	19701	MF5C	220330727
R110					220301927
R111	26.97K	1/8W .5%	19701	MF5C	220326927
R112	1.654K	1/8W .5%	19701	MF5C	220316517
R113	22.38K	1/8W .5%	19701	MF5C	220322327
R114	1.342K	1/8W .5%	19701	MF5C	220313417
R115					220302137
R116	1.2695K	1/8W .5%	19701	MF5C	220312617
S14		1A 00 28V	76854	269425-F4	625800900

SECTION 7

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION.

7.2 Figures 7–2 through 7–11 schematically illustrate all circuitry in the TTS 35B/BR. Figure 7–12 provides overall dimensions for installation of the rack-mounted Model TTS 35BR.

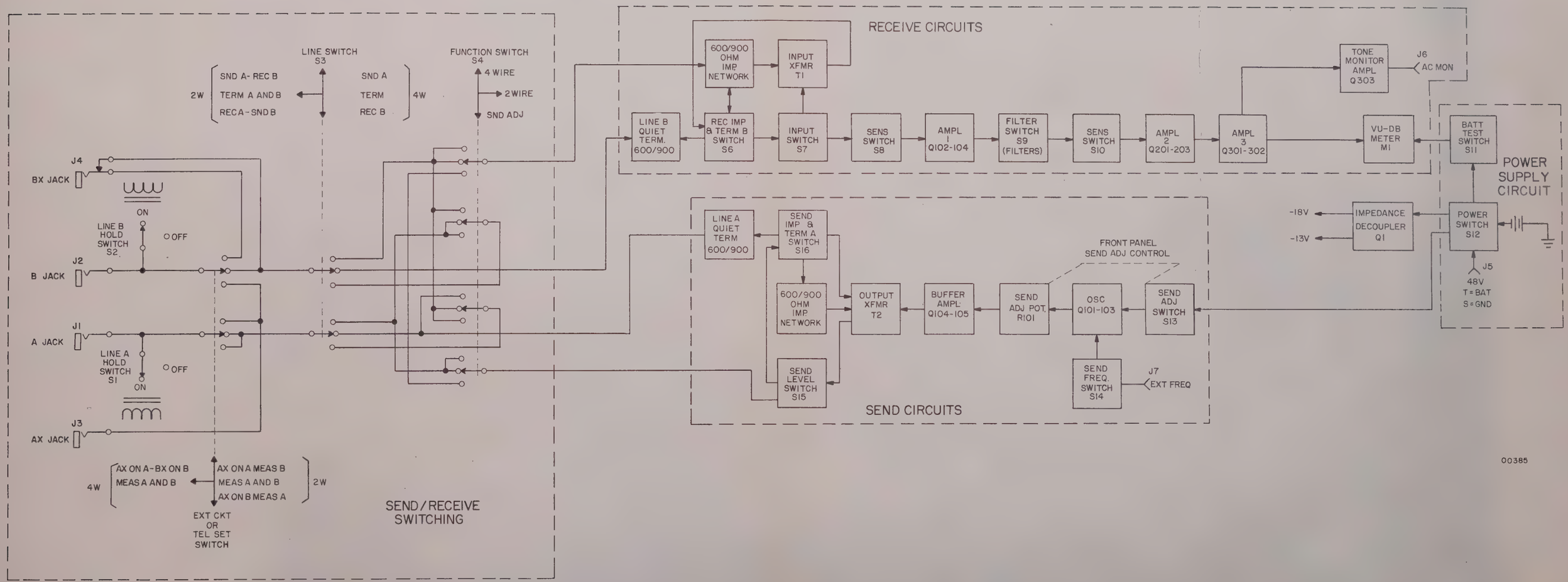
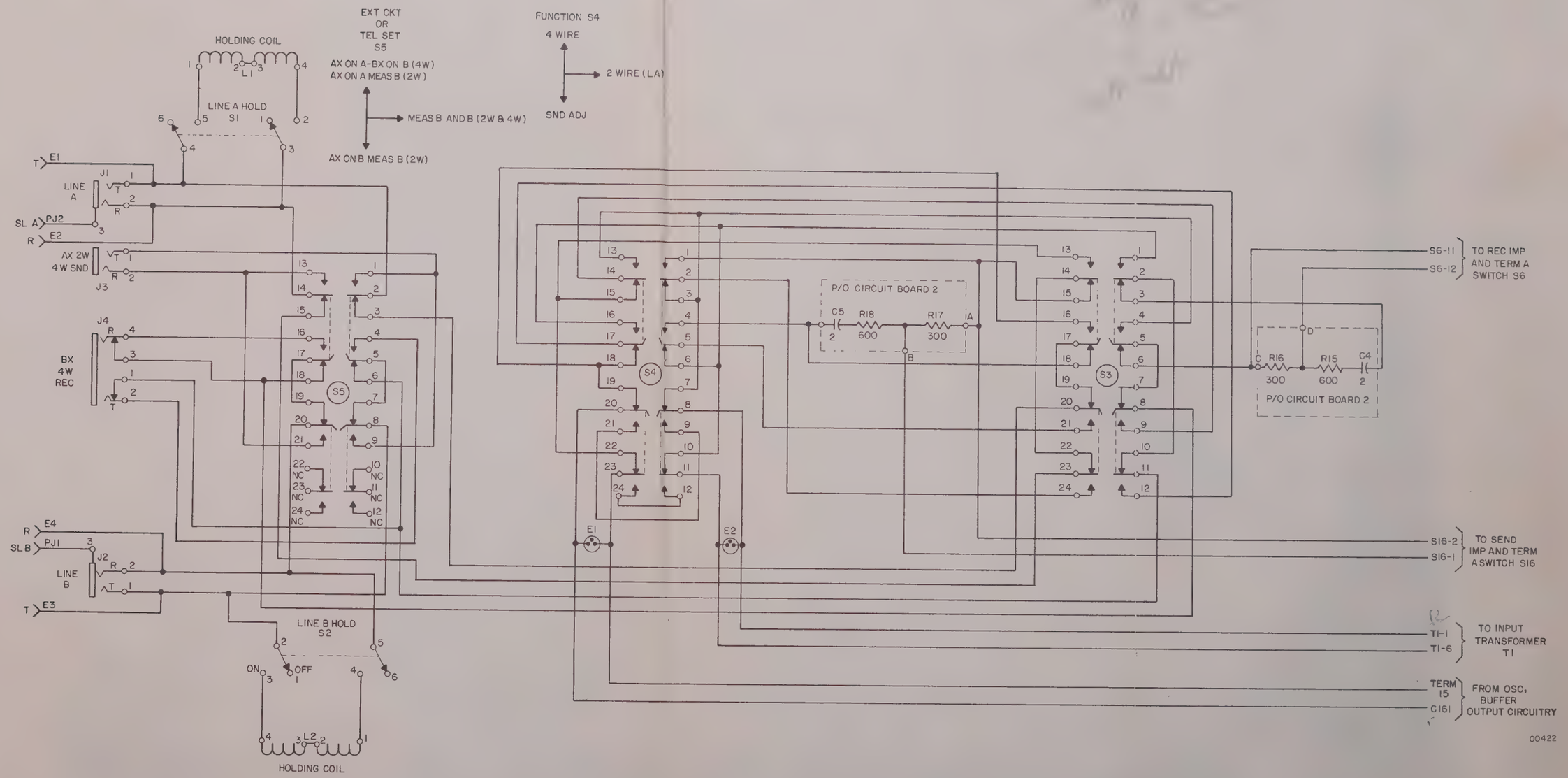
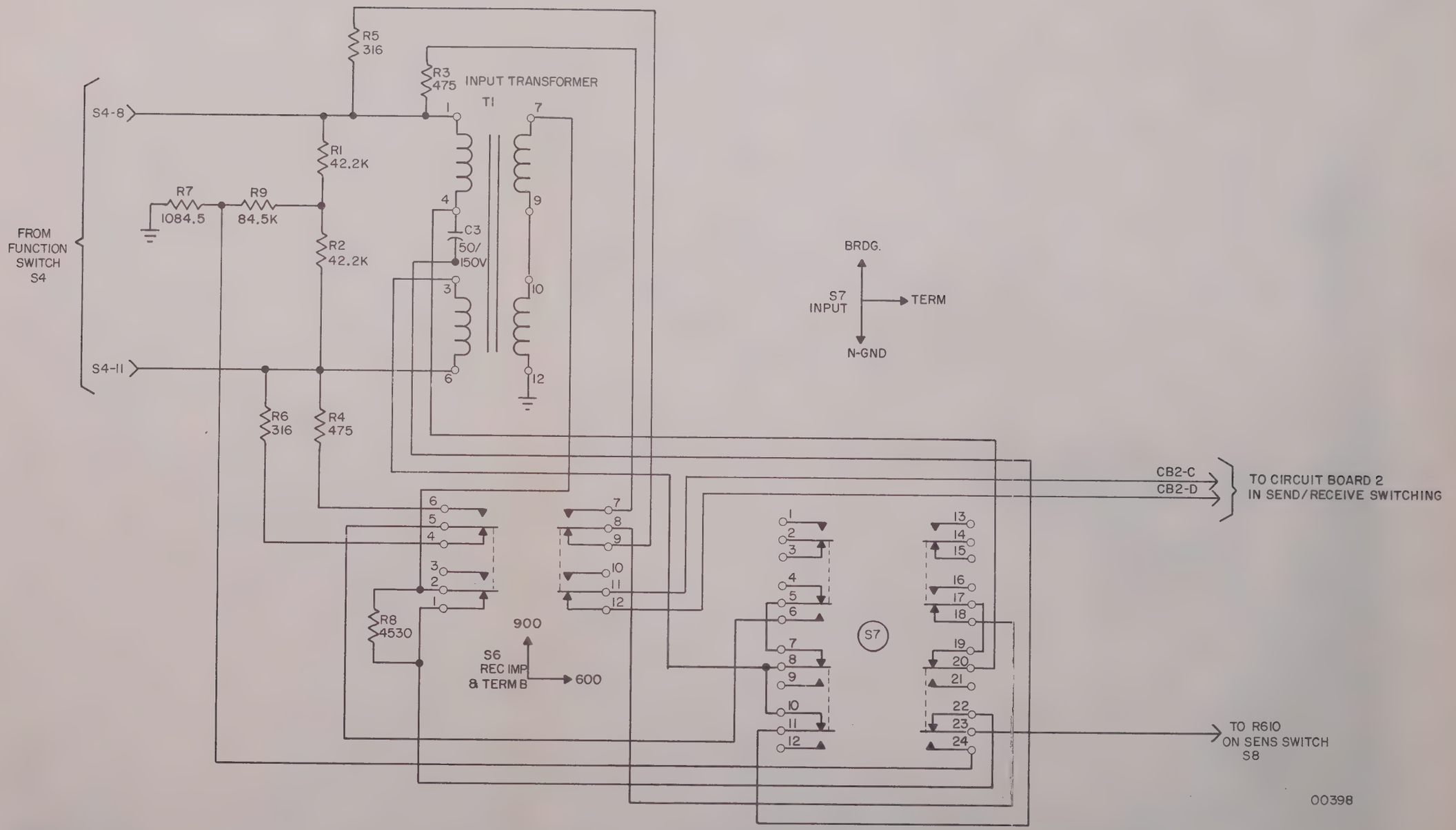


Figure 7–1. TTS 35B/BR Overall Simplified Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
2. S3, S4 AND S5 ARE SHOWN IN THE CENTER POSITION.

Figure 7–2. TTS 35B/BR Send/Receive Switching Schematic Diagrams



NOTE:
1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS ARE IN OHMS.

Figure 7–3. TTS 35B/BR Input Circuit Schematic Diagram

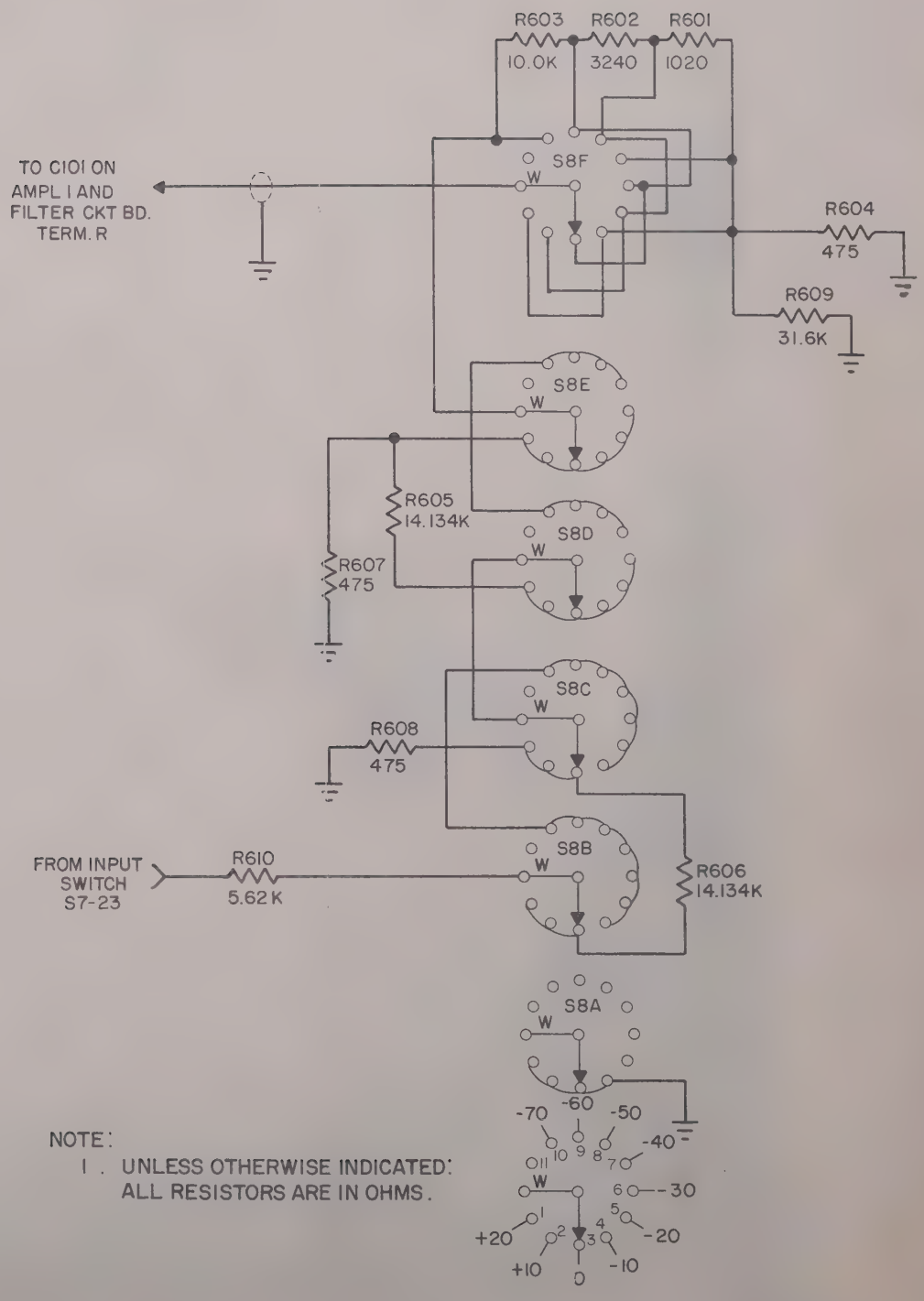
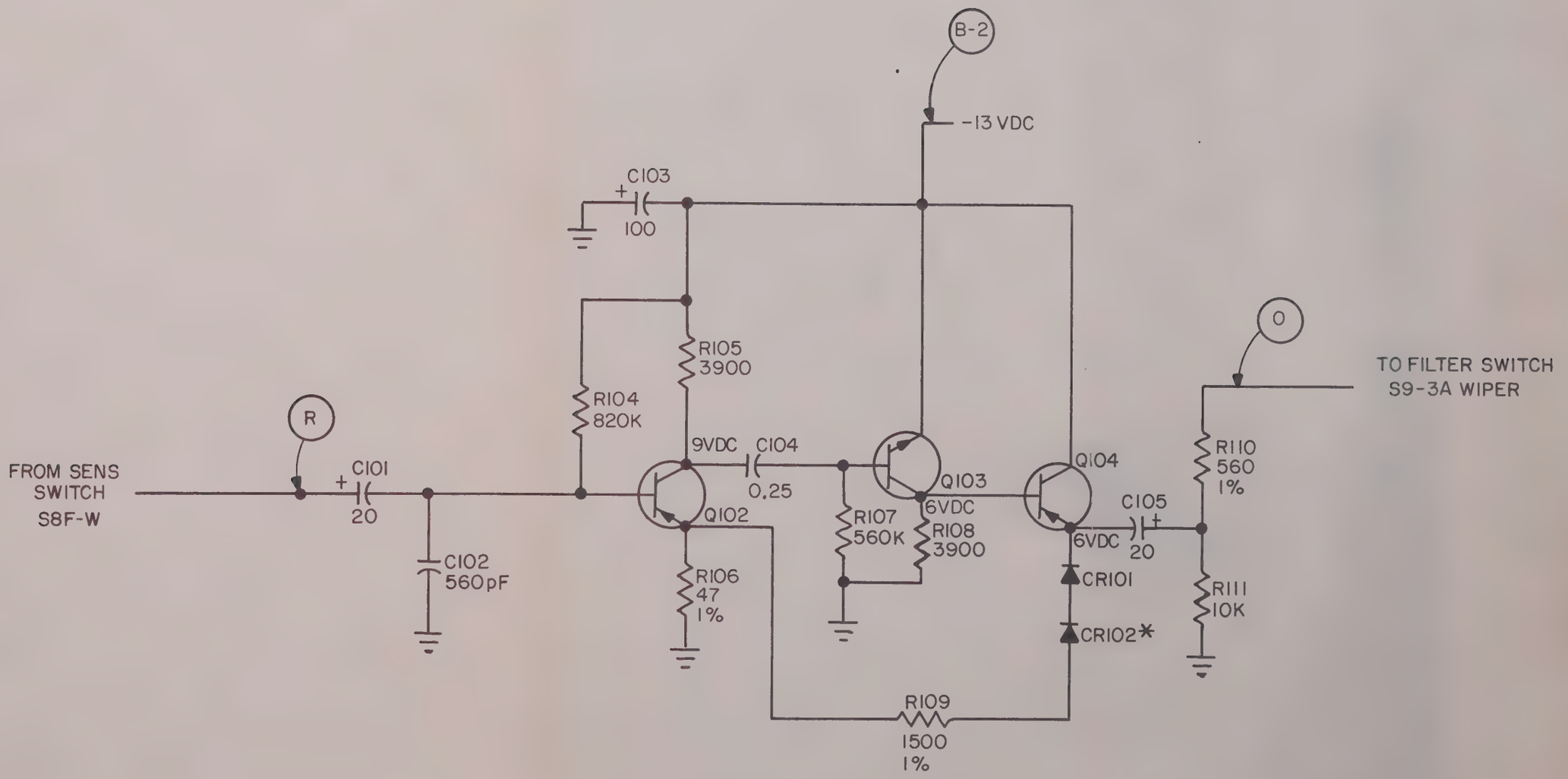


Figure 7–4. TTS 35B/BR 10 dB Step Attenuation (SENS Switch S8) Schematic Diagram



NOTES:

1. UNLESS OTHERWISE INDICATED: ALL CAPACITORS ARE IN MICROFARADS
2. * CR102 MAY BE STRAPPED IN SOME UNITS
3. CIRCLED TERMINALS, E.G., (B-2), ARE ON AMPL I & FILTER CKT BD.

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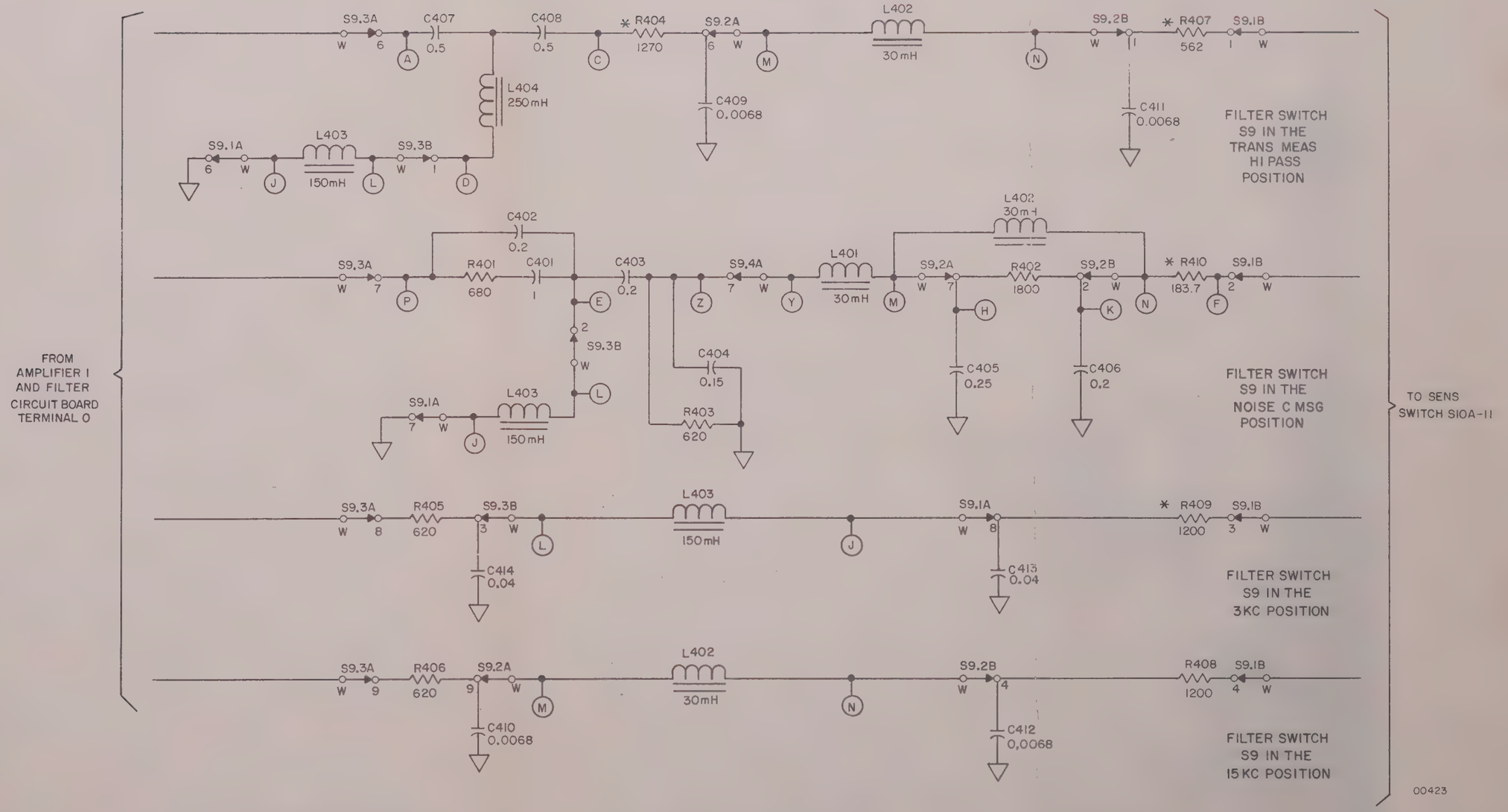
Figure 7–5. TTS 35B/BR Receive Amplifier 1 Schematic Diagram

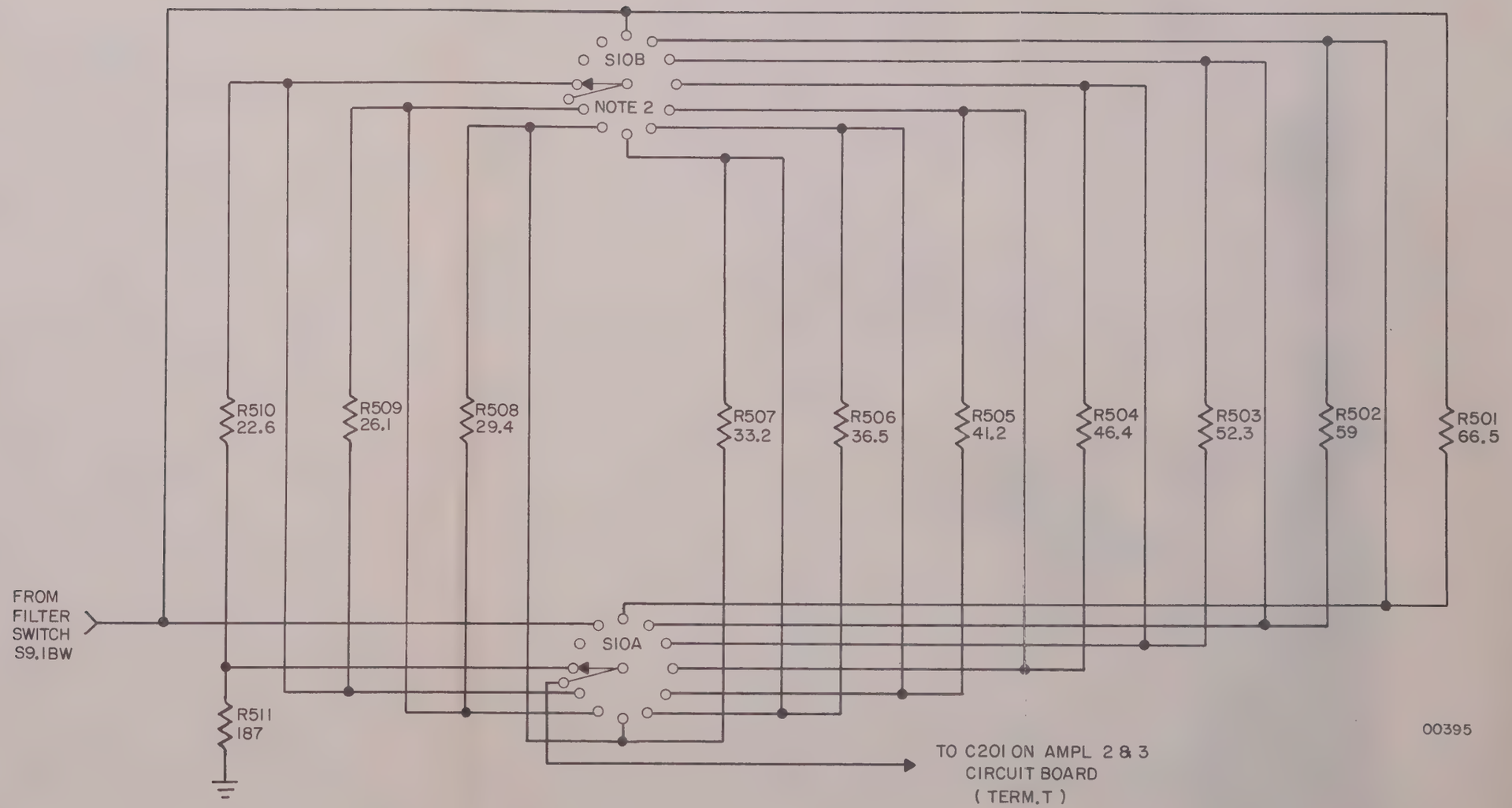
OLDER
THE OLD 37B BOOK FOR FLTR-SW



NOTES;

1. UNLESS OTHERWISE INDICATED RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN MICROFARADS.
2. CIRCLED LETTERS, e.g., L, REPRESENT TERMINALS ON THE AMPLIFIER I AND FILTER CIRCUIT BOARD
3. * ARE SELECTED VALUES; AVERAGE VALUES ARE SHOWN

Figure 7–6. TTS 35B/BR Filter Switching Network Schematic Diagram



NOTE:

1. UNLESS OTHERWISE INDICATED: ALL RESISTORS ARE IN OHMS.
2. S10B TERMINALS ARE USED AS TIE POINTS ONLY; THIS SWITCH SECTION IS NOT ACTIVE.

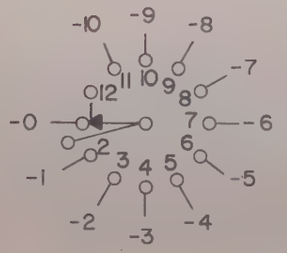
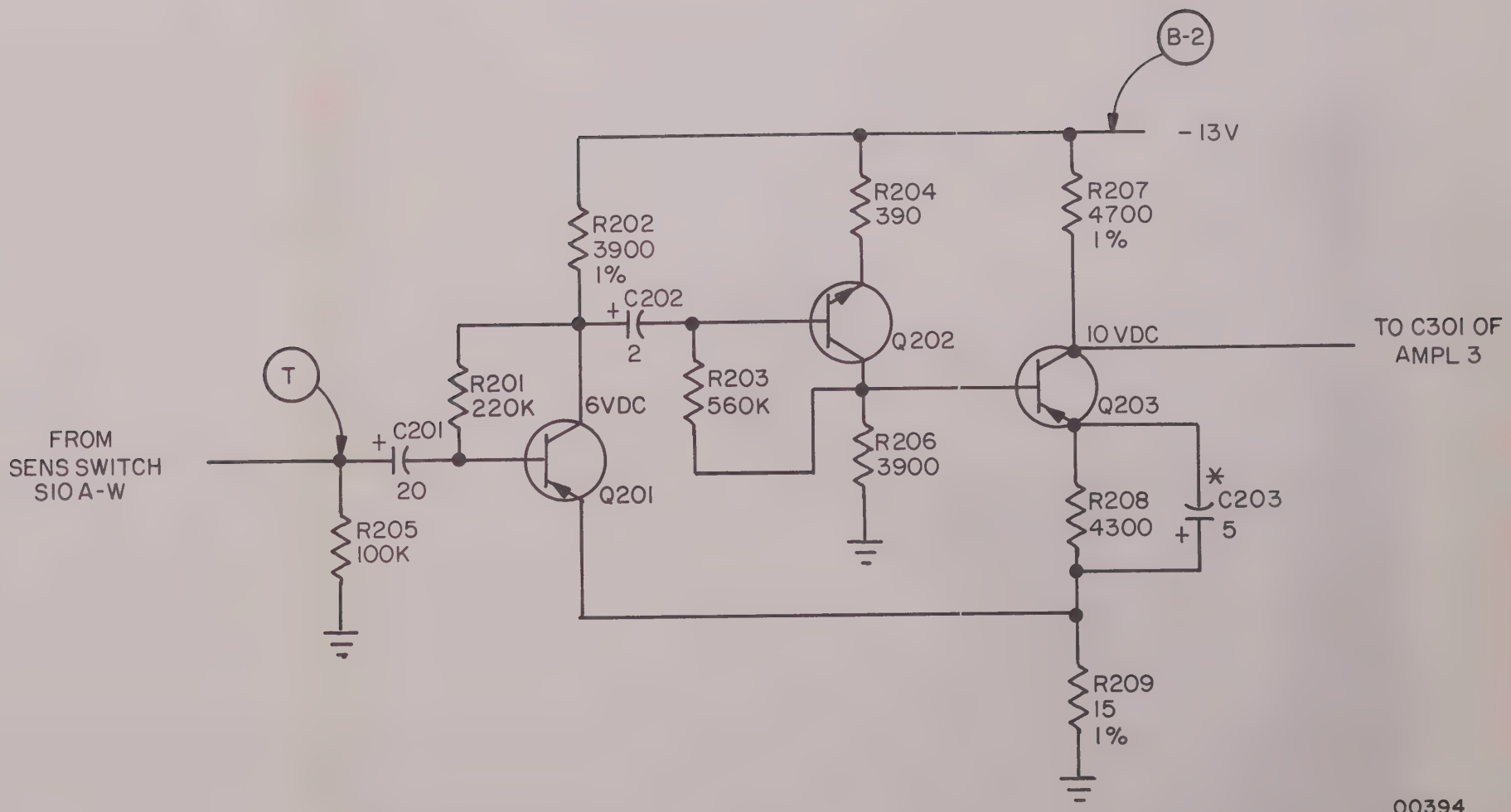


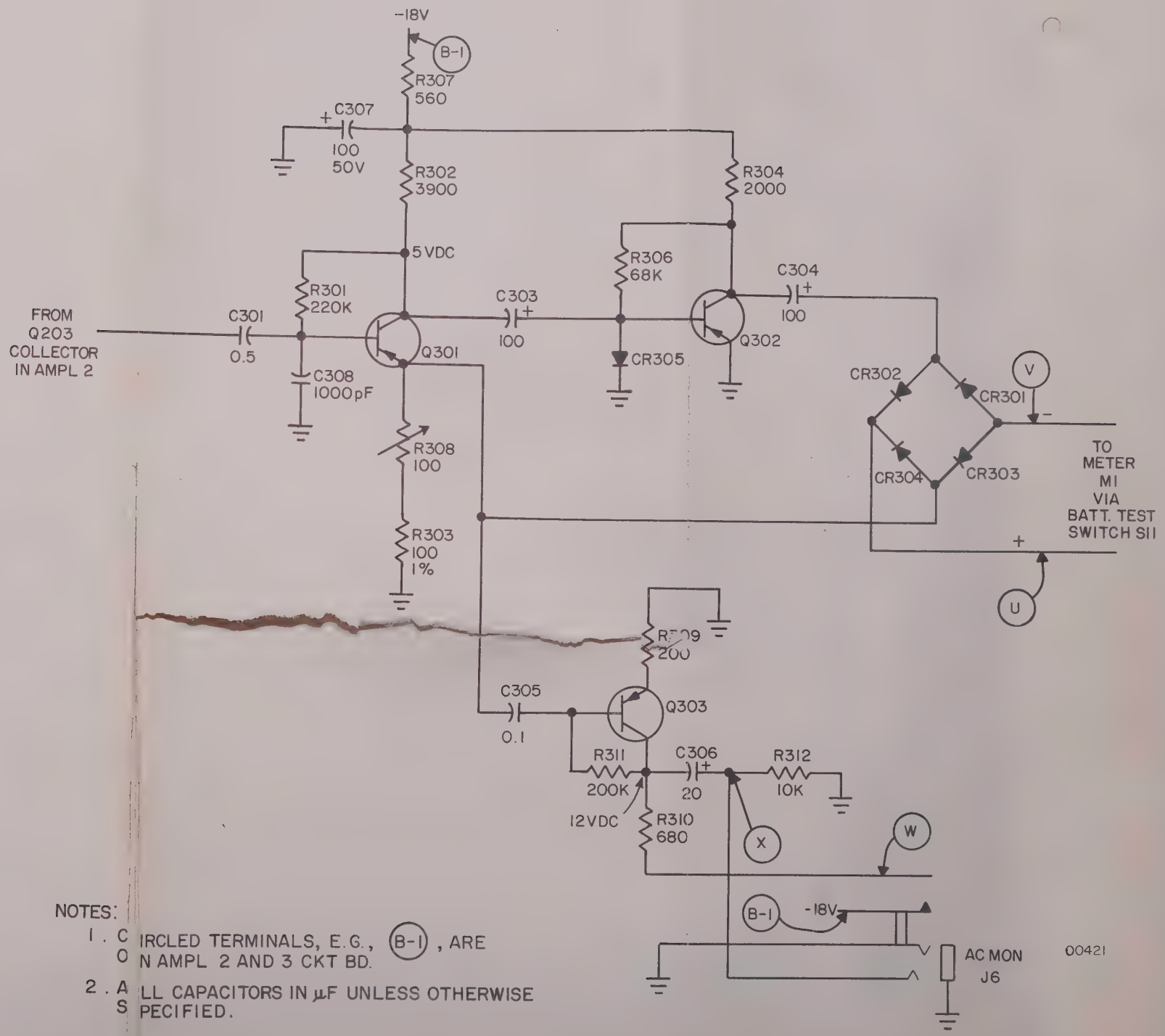
Figure 7–7. TTS 35B/BR 1 dB Step Attenuation (SENS Switch S10) Schematic Diagram



NOTES:

1. ALL CAPACITORS ARE IN MICROFARADS: UNLESS OTHERWISE INDICATED
2. * SELECTED VALUE, AVERAGE VALUE SHOWN
3. CIRCLED TERMINALS, E.G. (B-2), ARE ON AMPL 2 AND 3 CKT BOARD.

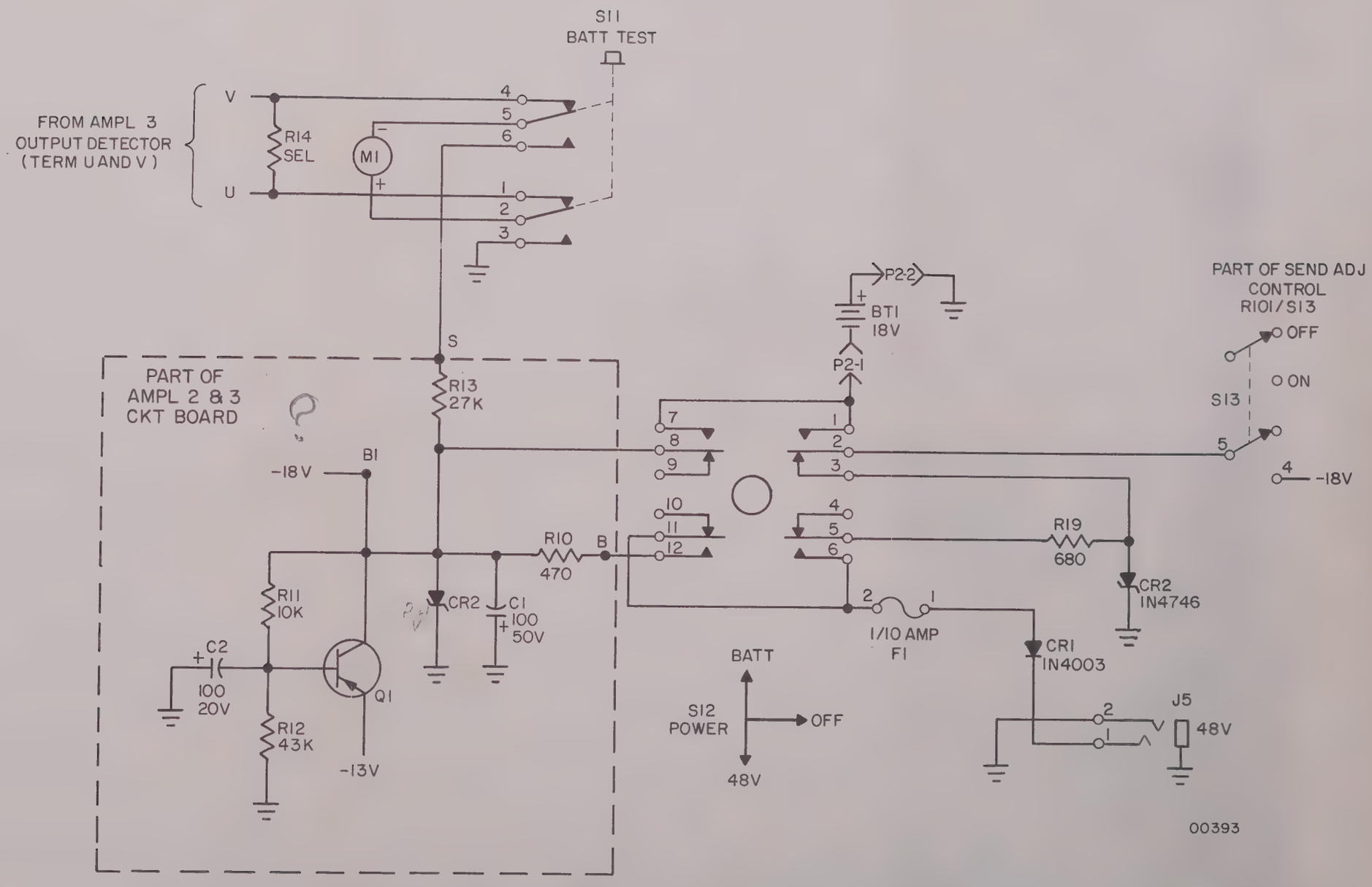
Figure 7–8. TTS 35B/BR Receive Amplifier 2 Schematic Diagram



NOTES:

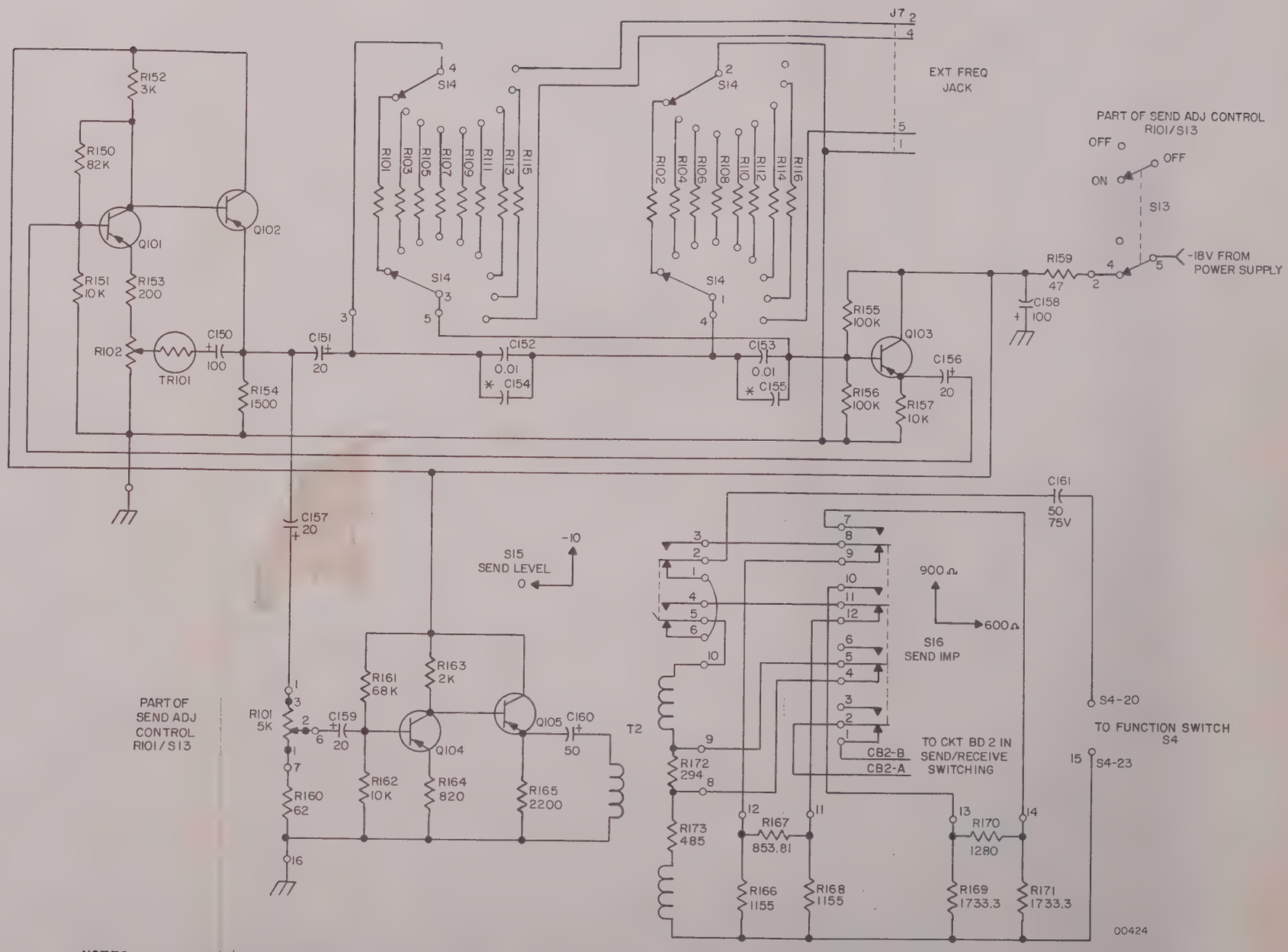
1. CIRCLED TERMINALS, E.G., (B-1), ARE ON AMPL 2 AND 3 CKT BD.
2. ALL CAPACITORS IN µF UNLESS OTHERWISE SPECIFIED.

Figure 7–9. TTS 35B/BR Receive Amplifier 3 Schematic Diagram



NOTE:
1. UNLESS OTHEWISE INDICATED ALL RESISTORS ARE IN OHMS.

Figure 7–10. TTS 35B/BR Meter and Power Supply Schematic Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
2. * INDICATES SELECTED VALUES.

LOCATOR 6-9

Figure 7–11. TTS 35B/BR Oscillator, Buffer Amplifier and Output Circuit Schematic Diagram

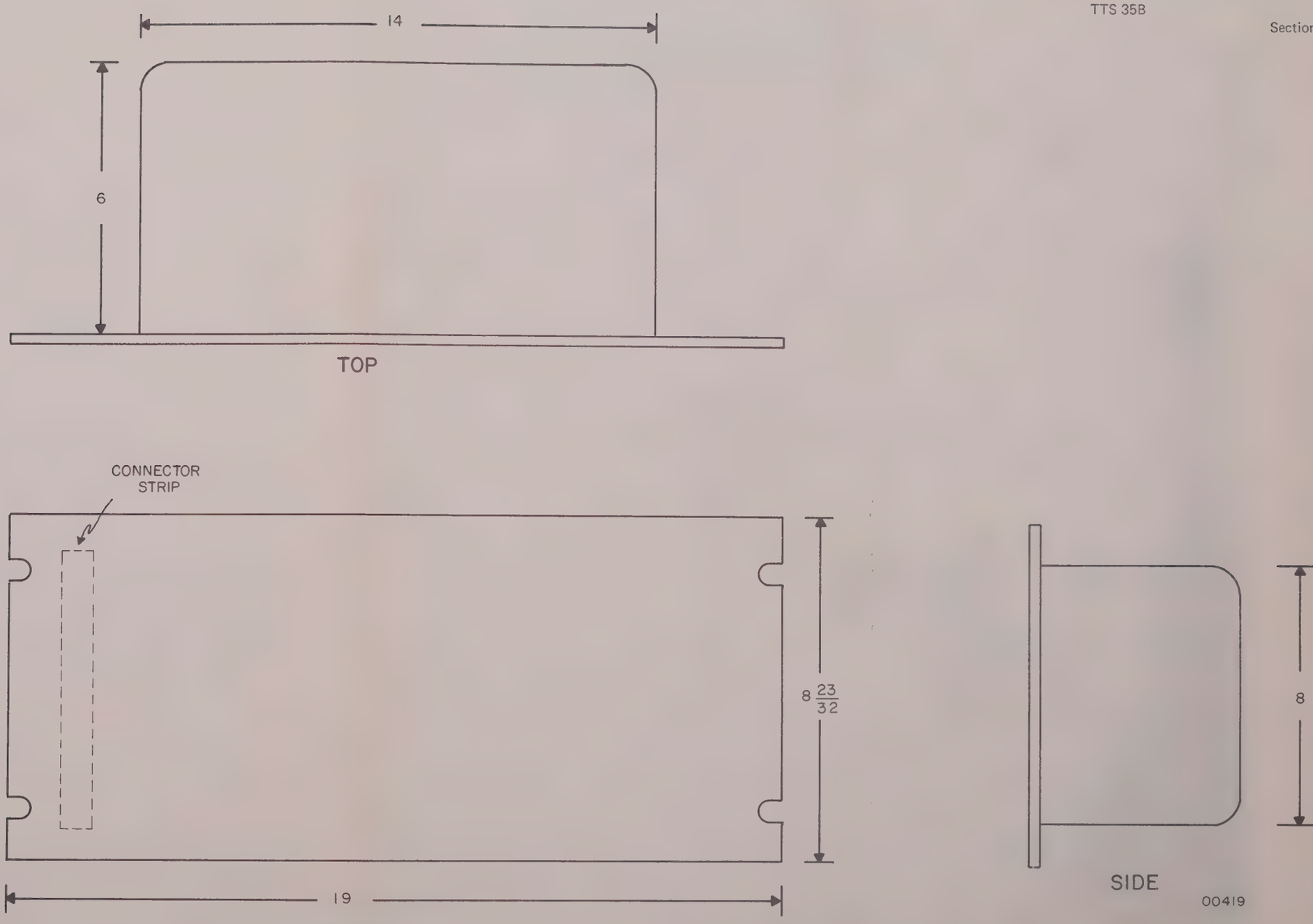


Figure 7–12. TTS 35BR Rack Mounted Unit Installation Diagram

APPENDIX 1

TTS 35XDT DIAL AND TALK ADAPTER

A1.1 DESCRIPTION.

A1.2 The Northeast Electronics Corporation Model TTS 35 XDT Dial and Talk Adapter is a cover accessory for the TTS 35 B/BAQ Transmission Test Set. A telephone dial and a two-way (duplex) talk circuit are the major components of the TTS 35 XDT.

A1.3 SPECIFICATIONS.

Dial and Voice Circuit: Standard telephone

Dimensions (including cover): 14"w x 8"h x 4½"d

Weight: approximately 3 pounds

A1.4 INSTALLATION AND OPERATING INSTRUCTIONS.

A1.5 INSTALLATION.

A1.6 No special installation procedures are required. The TTS 35XDT is mounted in the removable cover of the TTS 35B/BAQ. A rack-mounted version is available for use with the TTS 35BR.

A1.7 OPERATING PROCEDURE.

ACTION	RESULT
a. Patch two-wire cord between LINE jack J1 on TTS 35XDT and AX jack J3 on TTS 35B/BAQ as specified in TTS 35B operating procedures.	
b. Set OFF HOOK ON HOOK switch S1 to the OFF HOOK position.	Dial on TTS 35XDT is connected for dialing, as required by TTS 35B operating procedures.
c. Patch telephone set 52A to TEL SET jacks J2 and J3, with transmitter to J2 and receiver to J3.	Telephone set is connected for talking and monitoring, as required by TTS 35B operating procedures.

A1.8 CIRCUIT DESCRIPTION.

A1.9 Refer to Figure A1-2. The TTS 35XDT contains standard telephone dial and talk circuits; no special description is required.

A1.10 MAINTENANCE.

A1.11 No special maintenance is required.

A1.12 ELECTRONICS PARTS LIST.

A1.13 Manufacturers names and Federal Supply Code of Manufacturers (FSCM) numbers for parts in the TTS 35XDT are listed in Table 6–1 of the basic TTS 35B/BR manual, except for switch S1. Switch S1 is manufacturered by Arrow-Hart and Hegeman, Hartford, Conn. 06106, FSCM number 04009. Table A1–1 lists replacement parts alpha-numerically by reference designation. Figure A1–1 shows component locations on the circuit board in the TTS 35XDT.

Table A1–1. TTS 35XDT Overall Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.20MF 10% 100V	13606	225P2049R75ZD3	320002040
C2	.68MF 10% 200V	13606	118P68492S2	320106840
CR1	00 200V	12065	1N4003	560040030
CR2	SAME AS CR1			
J1	JACK,TEL,SWCRFT SCHEM 4	82389	L12B	650100300
J2	MI-D 00	82389	111	650100800
J3	SAME AS J2			
R1	12- 1/2W 5%	01121	TYPE EB	200201205
R2	47- 1/2W 10%	01121	TYPE EB	200204706
S1	SPST 6A 00 125V	04009	ST12A	620100100

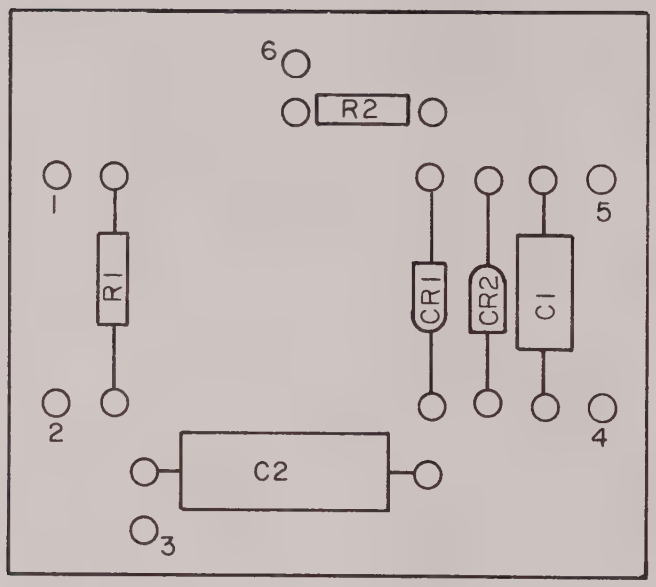


Figure A1–1. TTS 35XDT Circuit Board 1, Component Location Diagram

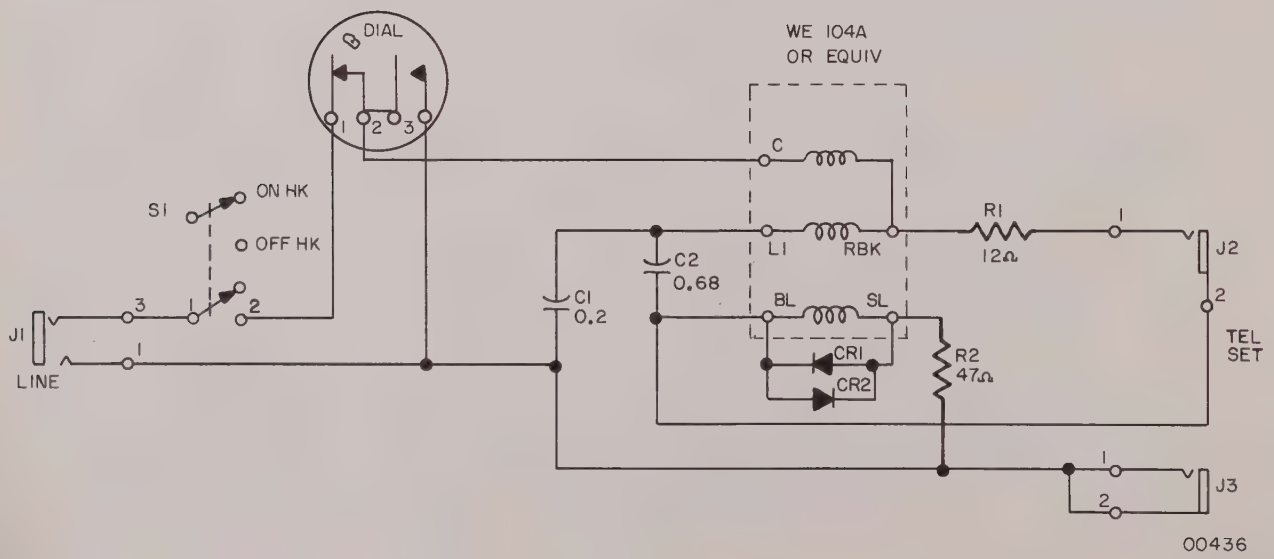


Figure A1–2. TTS 35XDT Dial and Talk Adapter, Schematic Diagram

APPENDIX 2

TTS 35XPS AC POWER SUPPLY ADAPTER

A2.1 DESCRIPTION.

A2.2 The Northeast Electronics Corporation Model TTS 35 XPS AC Power Supply Adapter is a cover accessory for the TTS 35B/BAQ Transmission Test Sets. A transformer and rectifier circuit in the TTS 35XPS converts 115V ac to 48V dc.

A2.3 SPECIFICATIONS.

Output Voltage:	48 volts dc
Input Voltage:	115 volts ac
Max. Load Current:	200mA
No-Load to Full-Load-Regulation:	70 volts dc to 45 volts dc
No-Load Output :	70 volts ±6 volts dc with ripple ≤0.05 volts p-p
Full-Load Output:	45 volts ±3 volts dc with ripple ≤1.0 volt p-p
Fuses:	0.5 amp input; 0.2 amp output
Size:	3 7/8"w x 7 13/16"h x 5"d
Weight:	4 lb.

A2.4 INSTALLATION AND OPERATING INSTRUCTIONS.

A2.5 INSTALLATION.

A2.6 No special installation procedures are required. The TTS 35XPS is mounted in the removable cover of the TTS 35B/BAQ.

A2.7 OPREATING PROCEDURE.

ACTION	RESULT
a. Set POWER switch S1 to the OFF position	
b. Connect ac power cord to 115 volt ac outlet.	
CAUTION Never connect the TTS 35XPS Power Supply to the TTS 35B/BAQ test set while the 35XPS is turned on. Also, do not disconnect these units while the 35XPS is turned on.	
c. Connect dc power cord from 48V connector J1 on TTS 35XPS to 48 V connector J5 on TTS 35B/BAQ.	
d. Set POWER switch S12 on the TTS 35B/BAQ to the 48V position.	TTS 35B/BAQ is set up to operate from external power.
e. Set POWER switch S1 on TTS 35XPS to the ON position.	Power is applied to the TTS 35B/BAQ.
f. Depress BATT TEST pushbutton S11 on TTS 35B/BAQ.	If meter M1 on TTS 35B/BAQ does not indicate GOOD, turn off the TTS 35XPS and ensure that the dc power cord is fully inserted at both connectors.

A2.8 CIRCUIT DESCRIPTION.

A2.9 Refer to Figure A2–2. Transformer T1 steps down primary voltage to approximately 35 volts, which is converted to dc voltage by fullwave bridge rectifier diodes CR1 through CR4. The resistor-capacitor filter network has the effect of doubling the rectified voltage to 70 volts dc under no-load conditions. With a proper load, i.e., the TTS 35B/BAQ, at 48V connector J1, output voltage stabilizes at 45V dc. The input and output circuits are protected by fuses F1 (0.5 amp) and F2 (0.2 amp) respectively. By adding 2000 ohms resistor R220 in the primary circuit of T1, the TTS 35XPS may be used with a 220V ac primary power source.

A2.10 MAINTENANCE.

A2.11 No special maintennace is required.

NOTE

No-load voltage output from TTS 35XPS is 70V dc.

A2.12 ELECTRONICS PARTS LIST.

A2.13 Manufacturers names and Federal Supply Code of Manufacturers (FSCM) numbers for parts in the TTS 35XPS are listed in Table 6–1of the basic TTS 35B/BR manual, except for switch S1. Switch S1 is manufacturered by Arrow-Hart and Hegeman, Hartford, Conn. 06106, FSCM number 04009. Table A2–1 lists replacement parts alpha-numerically by reference designators. Figure A2–1 shows component locations on the circuit board in the TTS 35XPS.

Table A2–1. TTS 35XPS Overall Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	100MF 00 150V	13606	TVA1420	300401071
C2	SAME AS C1			
CR1	00 200V	12065	1N4003	560040030
CR2	SAME AS CR1			
CR3	SAME AS CR1			
CR4	SAME AS CR1			
F1				836100300
J1	JACK,TEL,SWCRFT SCHEM 4	82389	L12B	650100300
R1	51- 1/2W 5%	01121	TYPE EB	200205105
R2	SAME AS R1			
S1	DPST 6A 00 125V	04009	ST26K	620100400
T1	35MA 00	81095	F-94X	420100200

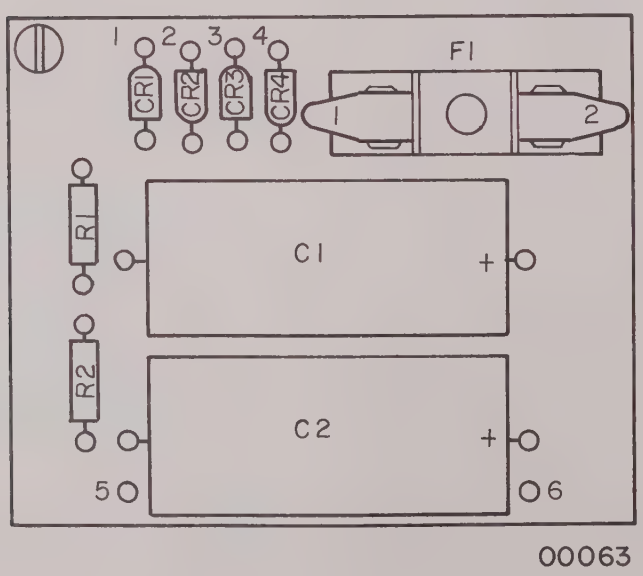
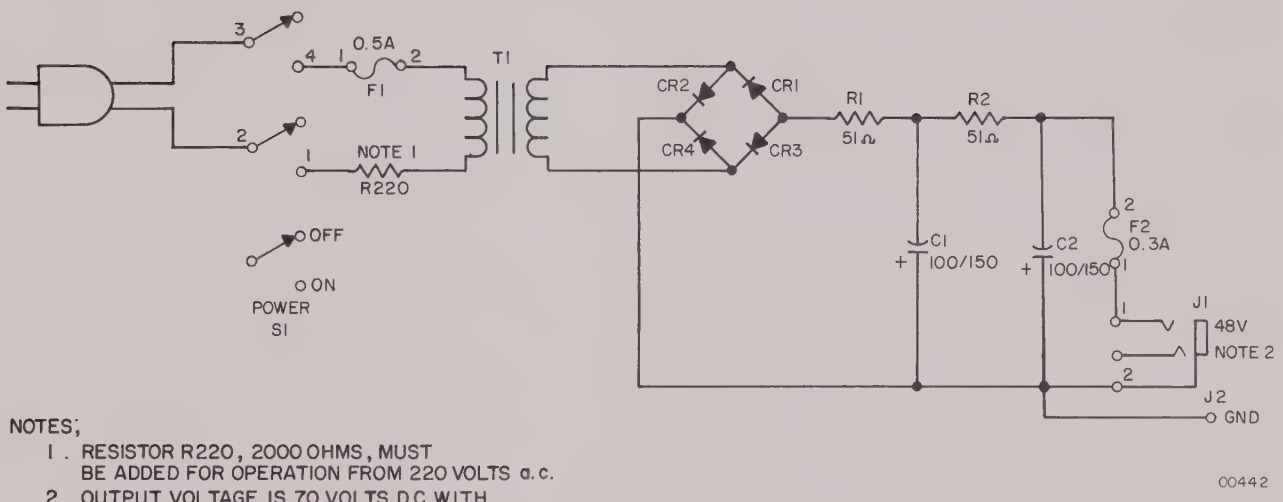


Figure A2–1. TTS 35XPS Circuit Board Assembly, Component Location Diagram



NOTES;

1. RESISTOR R220, 2000 OHMS, MUST BE ADDED FOR OPERATION FROM 220 VOLTS a.c.
2. OUTPUT VOLTAGE IS 70 VOLTS DC WITH NO LOAD.

Figure A2–2. TTS 35XPS AC Power Supply Adapter, Schematic Diagram

Appendix 3

TTS 35XV CONTINUOUSLY VARIABLE FREQUENCY ADAPTER

A3.1 DESCRIPTION.

A3.2 The Northeast Electronics Corporation Model TTS 35XV Continuously Variable Frequency Adapter is a cover accessory for the TTS 35B/BAQ Transmission Test Sets. The TTS 35B/BAQ is capbale of continuously variable frequency coverage from 200 Hz to 7000 Hz, in three ranges, when used with the TTS 35XV.

A3.3 SPECIFICATIONS.

Frequency ranges:	A - 200 to 700 Hz B - 600 to 2100 Hz AX10 - 2000 to 7000 Hz
Accuracy (When TTS 35XV is used with the TTS 35B/BAQ for which calibrated)	
Frequency:	±3% of scale
TTS 35B/BAQ oscillator output level:	Constant ±0.3 dB throughout frequency ranges
Dimensions (including cover):	14"w x 8"h x 4½"d
Weight:	3½ pounds

A3.4 INSTALLATION AND OPERATING INSTRUCTIONS.

A3.5 INSTALLATION.

A3.6 No special installation procedures are required. The TTS 35XV is mounted in the removable cover of the TTS 35B/BAQ. A rack-mounted version is available for use with the TTS 35BR.

A3.7 OPERATING PROCEDURE.

ACTION	RESULT
a. Insert the plug (on the 8 inch cable extending from the TTS 35XV) into EXT FREQ connector J7 on TTS 35B/BAQ.	
b. Set SEND FREQ switch S14 on TTS 35B/BAQ to the EXT position.	TTS 35B/BAQ send frequency is determined by the TTS 35XV.
c. Set RANGE switch S1 on TTS 35XV to the B position.	Frequency indicated on B scale determines TTS 35B/BAQ oscillator frequency.
d. Adjust SCALE control R1A/B on TTS 35XV to indicate 1000 on the B SCALE.	Oscillator in TTS 35B/BAQ will provide a 1 kHz signal when operated in accordance with instructions for sending.
e. Set up the controls and switches as instructed in the TTS 35B/BAQ manual and adjust the send level to 0 dBm.	The TTS 35B/BAQ will send at any desired frequency, as determined by RANGE switch S1 and SCALE control R1 on the TTS 35XV.

NOTE

When the oscillator in the TTS 35B/BAQ is switched from external frequency control to fixed (internal) frequency control and vice-versa, the send level should be readjusted to 0 dBm.

A3.8 CIRCUIT DESCRIPTION.

A3.9 Refer to Figure A3–2. Ganged potentiometers R1A and R1B are mechanically coupled to the SCALE control to provide the continuously variable frequency determining network for TTS 35B/BAQ test sets. Potentiometers R2 through R7 are calibrated in pairs to ensure amplitude and frequency tracking throughout the three ranges. Capacitors C1 through C6 are fixed pads for the high and low ends of each range.

A3.10 MAINTENANCE AND CALIBRATION.

A3.11 No special maintenance is required. Because of the critical adjustments required for calibration, the TTS 35XV should be returned to the factory with the basic test set for repairs.

A3.12 ELECTRONIC PARTS LIST.

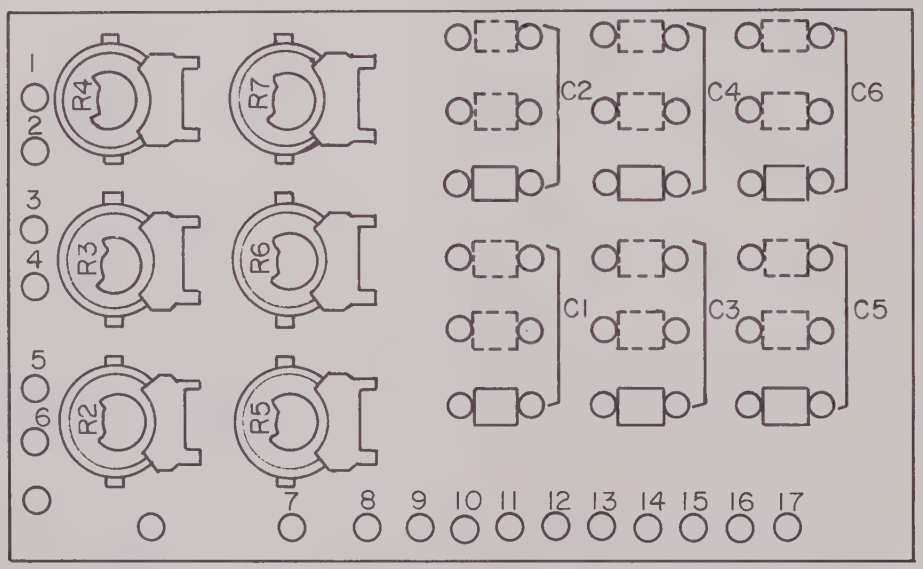
A3.13 Manufacturers names and Federal Supply Code of Manufacturers (FSCM) numbers for parts in the TTS 35XV are listed in Table 6–1 of the basic TTS 35B/BAQ manual, except for potentiometer R1. Potentiometer R1 is manufactured by Waters Mfg. Inc., Wayland, Mass. 01778, FSCM number 94604. Table A3–1 lists replacement parts alpha-numerically by reference designation. Figure A3–1 shows component locations on the circuit board in the TTS 35XV.

Table A3–1. TTS 35XV Overall Assembly Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
P1	5–PIN MALE PLUG RT ANGLE	82389	12DL5M	652300300
PC1	PC BRD ASSY	06819		A001552005
R1	1K–15K 2W 5%	94604	PT112W147	238001020
S1	AVOID IN NEW DESIGN 15XV	76854	0401003051001202A	626400200

Table A3–2. TTS 35XV Printed Circuit Board Assembly E–95682 Parts List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1–6	sel val 10%	13606	225P	320000000
R2–4	5K ¼W 10%	71450	UPE200RE1–SQ8516	231305020
R5–7	500 ¼W 10%	71450	UPE200RE1–SQ8515	231305010



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NOTE:

CAPACITORS C1 THRU C6 ARE SELECTED VALUES ONE, TWO, OR THREE CAPACITORS MAY BE MOUNTED ON THE DESIGNATED TERMINALS TO PRODUCE THE REQUIRED VALUE.

Figure A3–1. TTS 35XV Circuit Board Assembly, Component Location Diagram

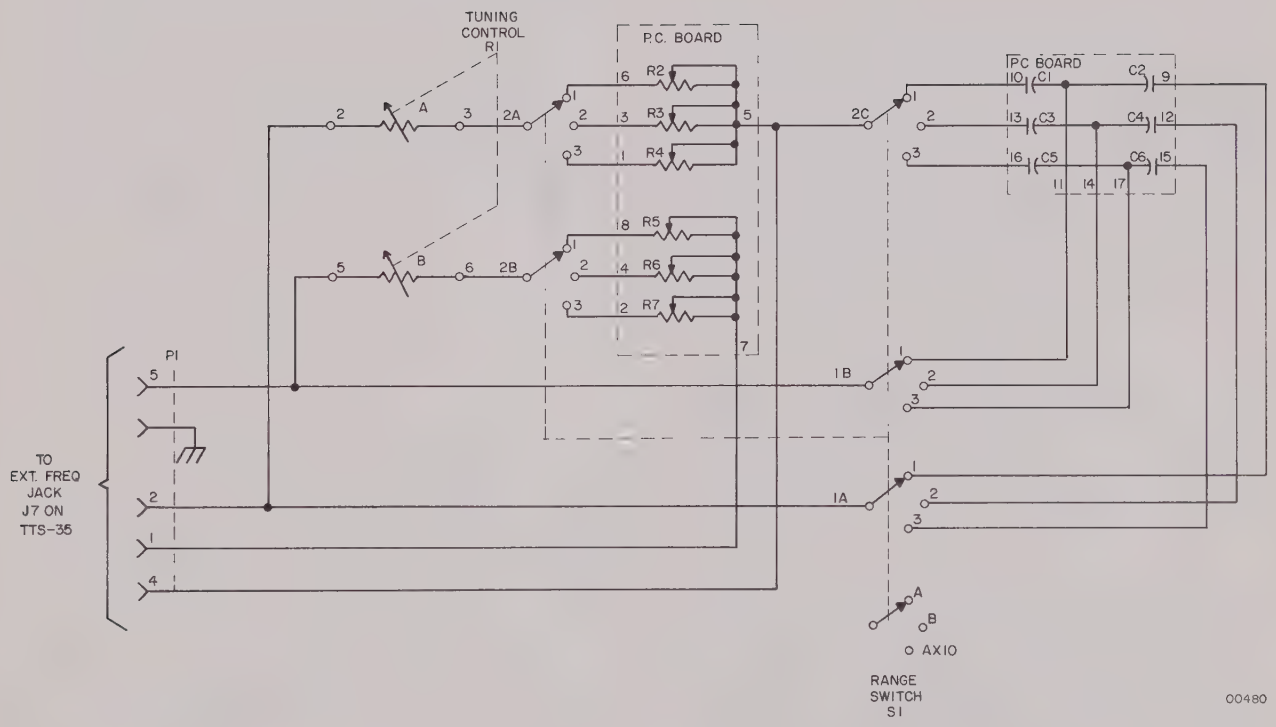


Figure A3–2. TTS 35XV Continuously Variable Frequency Adapter, Schematic Diagram

Appendix 4

TTS 35BAQ TRANSMISSION TEST SET

A4.1 DESCRIPTION.

A4.2 The Northeast Electronics Corporation Model TTS 35 BAQ Transmission Test Set includes all the physical features and operating characteristics of the TTS 35B, plus a Q-RMS Detector circuit. Positioning of the FILTER switch on the front panel selects the desired filter network, and also selects either amplifier 3 or the Q-RMS detector to drive the VU-DB meter. With this one exception, the description in Section 1 of the TTS 35B manual applies to the TTS 35BAQ. Also, the accessories described for the TTS 35B may be used with the TTS 35BAQ.

A4.4 TTS 35BAQ Option 8 offers a selection of fixed frequencies as follows: 300Hz, 400Hz, 500Hz, 1000Hz, 2300Hz, 2500Hz, 2800Hz, 3000Hz, 3100Hz, and 3200Hz. The TTS 35 XV Continuously Variable Frequency Adapter may be used with the TTS 35BAQ Option 8 as well as with the standard model TTS 35BAQ.

A4.5 SPECIFICATIONS.

A4.6 The specifications listed in Section 2 for the TTS 35B apply equally to the TTS 35BAQ.

A4.7 OPERATION.

A4.8 The operating instructions provided in Section 3 for the TTS 35B apply equally to the TTS 35BAQ, except for positioning of FILTER switch S9. If average values of direct current are to be indicated on VU-DB meter M1, the operator of the TTS 35BAQ must use the FILTER switch positions (first two positions on the left) identified by black panel marking. If quasi-rms values are to be indicated on the VU-DB meter, FILTER switch positions (last three positions on the right) identified by blue panel marking must be used.

A4.9 CIRCUIT DESCRIPTION.

A4.10 INTRODUCTION.

A4.11 Major differences between the TTS 35BAQ and the TTS 35B are in the final stages of the receive circuitry between amplifier 2 and the VU-DB meter, and in FILTER switch S9. Paragraph A4.13 describes these differences at the block diagram level; paragraphs A4.15 through A4.22 describe them at the schematic diagram level. A brief description of Option 8 is given in paragraph A4.24.

A4.12 OVERALL CIRCUIT DESCRIPTION.

A4.13 Refer to Figure A4–3. Received signals from amplifier 2 are connected through FILTER switch S9 to amplifier 3 or the Q-RMS detector, depending upon the position of the FILTER switch. In the TRANS MEAS HI-PASS and 15KC (black) positions of the switch, amplifier 3 is selected to convert received audio signals into average values of direct current for display on VU-DB meter M1. When a plug is inserted in AC MON jack J6, tone monitor amplifier Q303 is turned on (through contacts of switch S9) to supply audio at the AC MON jack. In the remaining three positions of the FILTER switch, the Q-RMS detector is selected to convert received audio signals into quasi-rms values of direct current for display on the meter. For these three positions, the FILTER switch turns on tone monitor amplifier Q8 to supply audio to the AC MON jack. All other TTS 35BAQ circuit functions are the same as in the TTS 35B.

A4.14 DETAILED CIRCUIT DESCRIPTION.

A4.15 Q-RMS Detector.

A4.16 Refer to Figure A4–4. Audio at the IN terminal is amplified by two-stage amplifier Q1 and Q4. Bootstrap amplifier Q2 provides isolation for the two-stage amplifier by increasing the impedance at the collector of Q4. Transistors Q3,Q5,Q6, and Q7 form a full-wave rectifier circuit to convert the audio signal to quasi-rms current for measurement by VU-DB meter M1 on the front panel. The overall sensitivity of the quasi-rms detector circuit is –20 dB. Capacitors C7 and C8 recombine the rectified output for use in the gain adjustment network (potentiometer R17) and in tone monitor amplifier Q8.

A4.17 AMPLIFIER 3/Q-RMS DETECTOR SWITCHING.

A4.18 In the TTS 35BAQ, FILTER switch S9 has one position and two decks more than the FILTER switch in the TTS 35B. The additional decks are used to switch amplifier 3 or the quasi-rms detector into the receive circuit, dependent upon the filter network that is selected. The additional position permits use of the 15kHz filter network with either amplifier 3 or the quasi-rms detector.

A4.19 Refer to Figure A4–5. With FILTER switch S9 in the TRANS MEAS HI-PASS or 15KC (black) position, the TTS 35BAQ receive circuits function identically to those in the TTS 35B. The output of amplifier 2 (terminal Z on PC2) is connected to the input (Terminal ZA on PC2) of amplifier 3 through the wiper and contact 8 or 7 of S9.6B. Output from amplifier 3 (terminals U and V on PC2) is connected through contacts of S9.7A and S9.7B to VU-DB meter M1 via BATT TEST switch S11. Collector voltage is applied to monitor amplifier Q303, via wiper and contact 1 or 2 of S9.6A, when a plug is inserted in AC MON jack J6.

A4.20 With FILTER switch S9 in the NOISE C MSG, 3KC, or 15KC (blue) position, amplifier 3 is switched out of the receive circuits in the TTS 35BAQ and the quasi-rms detector is switched in. The output of amplifier 2 is connected to the input (terminal IN on PC4) of the quasi-rms detector through the wiper and contact 9,10, or 11 of S9.6B. Output from the quasi-rms detector (terminals U and V on PC4) is connected through contacts of S9.7A and S9.7B to VU-DB meter M1 via BATT TEST switch S11. Collector voltage is applied to monitor amplifier Q8, via wiper and contact 3,4, or 5 of S9.6A, when a plug is inserted in AC MON jack J6.

A4.21 FILTER SWITCHING.

A4.22 Refer to Figure A4–6. FILTER switch S9 in the TTS 35BAQ has one position more than the FILTER switch in the TTS 35B, which provides two 15KC positions for the 15kHz

filter network. Also FILTER switch contact and deck section identification in the TTS 35BAQ is different from that in the TTS 35B. The filter networks and response characteristics for the TTS 35BAQ are identical to those for the TTS 35B.

A4.23 OPTION 8 FREQUENCY SELECTION.

A4.24 Refer to Figure A4–7. Except for different resistance values and two additional positions of SEND FREQ switch S14, the TTS 35BAQ Option 8 frequency selection circuit is identical to that shwon in Figure 7–11 for the TTS 35B.

A4.25 MAINTENANCE AND CALIBRATION.

A4.26 Maintenance and calibration procedures described in Section 5 for the TTS 35B apply equally to the TTS 35BAQ.

A4.27 ELECTRONIC PARTS LIST.

A4.28 Manufacturers names and Federal Supply Code of Manufacturers (FSCM) numbers for parts in the TTS 35BAQ are listed in Table 6–1of the basic TTS 35B/BR manual,except for potentiometer R17 and capacitors C2 and C3 on PC4. Potentiometer R17 is manufacturered by 'Heli-Pot' Division of Beckman Instruments, Fullerton, Calif. 92634, FSCM number 73138; capacitors C2 and C3 are manufactured by 'Kemet' Division of Union Carbide Corp., New York, N.Y. 10017, FSCM number 05397. Replacement parts for the TTS 35BAQ that are different from or in addition to parts for the TTS 35B are listed alpha-numerically by reference designation in Tables 4–1 and A4–2. Figure A4–1 shows component locations on Q-RMS Detector Circuit Board PC4 in the TTS 35BAQ, and Figure A4–2 shows the differences between PC2 in TTS 35B and PC2 in the TTS 35BAQ.

NOTE

All other parts and component locations in the TTS 35BAQ are the same as in the TTS 35B; refer to the parts lists and diagrams in Section 6 of the TTS 35B manual.

Table A4–1. TTS 35BAQ Quasi-RMS Detector
Circuit Board PC4 Assembly Parts List (Ref. Fig. A4–6)

REFERENCE DESIGNATOR	DESCRIPTION		MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.22MF	10% 100V	13606	225P2249R75Z03	320002240
C2	4.7MF	10% 75V	05397	T330A475K025AS	310004751
C3	10MF	10% 10V	05397	T330A106K010AS	310001060
C4	.1MF	10% 100V	13606	225P10491WD3	320001040
C5	22MF	10% 15V	13606	150D226X9015B2	310302260
C6	SAME AS C5				
C7	10MF	10% 20V	13606	150D106X9020B2	310301060
C8	SAME AS C7				
C9	56MF	10% 15V	13606	150D566X9015R2	310305660
C10	SAME AS C9				
C11	.1MF	30% 75V	71590	DDA-104	330201040
C12	20MF	00 50V	13606	TE1305	300202061
CR1	DO35	500MW 00 20V	12065	1N4148	560041480
Q1	TO92HSS	310MW 00 40V	04713	2N3903	550039030
Q2	TO92MSS	310MW 00 40V	04713	2N3905	552039050
Q3	SAME AS Q2				
Q4	SAME AS Q2				
Q5	SAME AS Q1				
Q6	SAME AS Q2				
Q7	SAME AS Q1				
Q8	SAME AS Q2				
R1	4.7K	1/2W 10%	01121	TYPE EB	200204726
R2	330K	1/2W 10%	01121	TYPE EB	200203346
R3	100K	1/2W 10%	01121	TYPE EB	200201046
R4	6.8K	1/2W 5%	01121	TYPE EB	200206825
R5	15K	1/2W 5%	01121	TYPE EB	200201535
R6	SAME AS R5				
R7	5.6K	1/2W 10%	01121	EB	200205626
R8	1.2K	1/2W 10%	01121	TYPE EB	200201226
R9	SAME AS R8				
R10	100-	1/2W 10%	01121	TYPE EB	200201016
R11	33-	1/2W 5%	01121	TYPE EB	200203305

Table A4–1. (cont)

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.F.C. PART NO.
R12	SAME AS R11			
R13	3.3K 1/2W 10%	01121	TYPE EB	200203326
R14	SAME AS R13			
R15	820- 1/2W 10%	01121	TYPE EB	200208216
R16	150- 1/2W 10%	01121	TYPE EB	200201516
R17	100- 1/2W 10% 200V HILIPOT	62P100		232701016
R18	SAME AS R10			
R19	220- 1/2W 10%	01121	TYPE EB	200202216
R20	220K 1/2W 10%	01121	TYPE EB	200202246

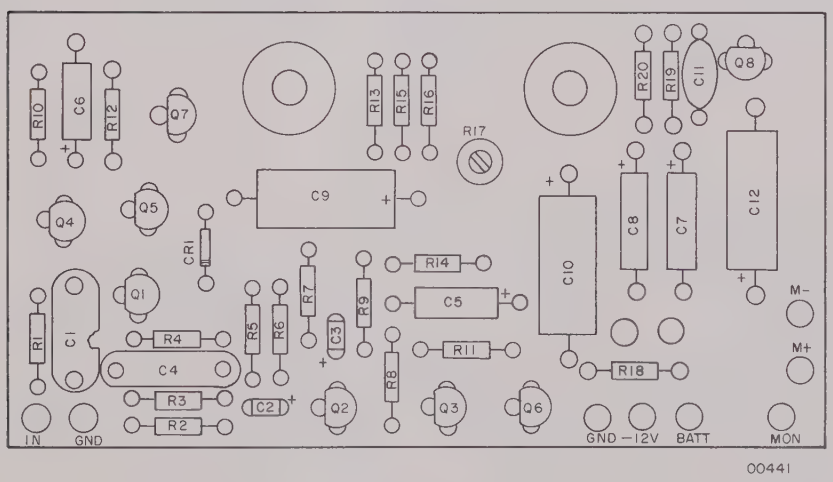


Figure A4–1. TTS 35BAQ Q-RMS Detector Circuit Board PC4, Component Location Diagram

Table A4–2. TTS 4BAQ Option 8 Send Frequency Switch S14 and Resistor Assembly Parrs List

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
R101	145.5K 1/8W 5%	19701	MF5C	220314537
R102	12.78K 1/8W 5%	19701	MF5C	220312727
R103	118.82K 1/8W 5%	19701	MF5C	220311837
R104	9.637K 1/8W 5%	19701	MF5C	220396317
R105	113K 1/8W 5%	19701	MF5C	220311337
R106	7.5K 1/8W 5%	19701	MF5C	220375017
R107	57.39K 1/8W 5%	19701	MF5C	220357327
R108	3.809K 1/8W 5%	19701	MF5C	220338017
R109	26.97K 1/8W 5%	19701	MF5C	220326927
R110	1.654K 1/8W 5%	19701	MF5C	220316517
R111-112	sel val 5%	19701	MF5C	220300000
R113	22.38K 1/8W 5%	19701	MF5C	220322327
R114	1.342K 1/8W 5%	19701	MF5C	220313417
R115	21.06K 1/8W 5%	19701	MF5C	220321027
R116	1.2695K 1/8W 5%	19701	MF5C	220312617
R117	21.06K 1/8W 5%	19701	MF5C	220321027
R118	1.27K 1/8W 5%	19701	MF5C	220312717
R119	20.5K 1/8W 5%	19701	MF5C	220220521
S14	4D-1CKT-11 POS SHORT	76854	269425-F4	625800900

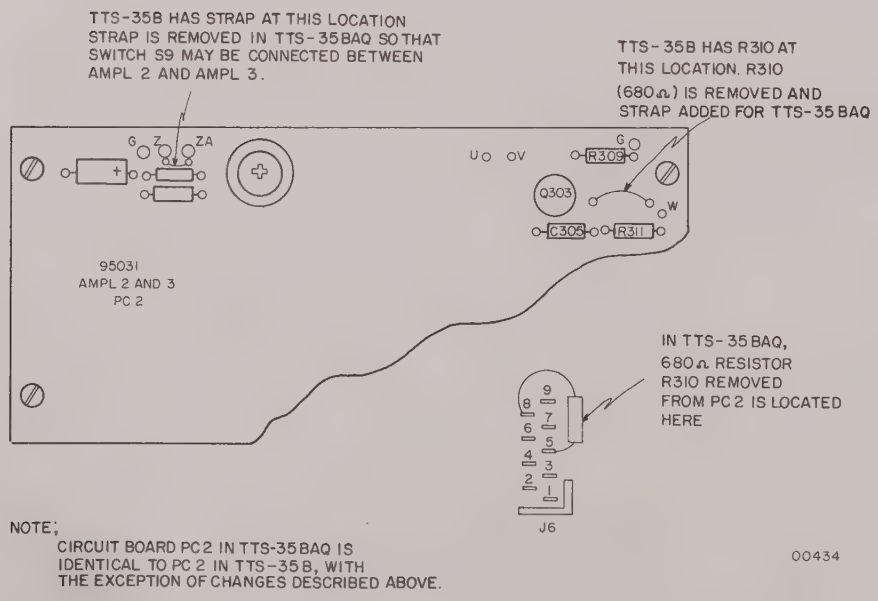


Figure A4–2. TTS 35BAQ Amplifiers 2 and 3 Circuit Board PC2, Component Location Change Diagram

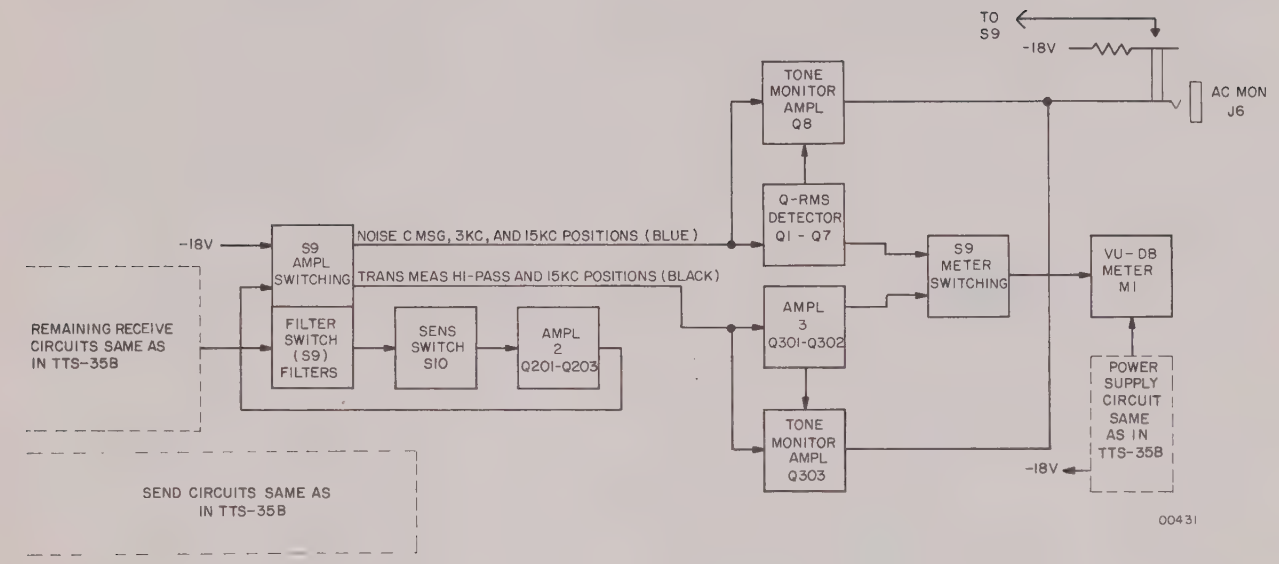
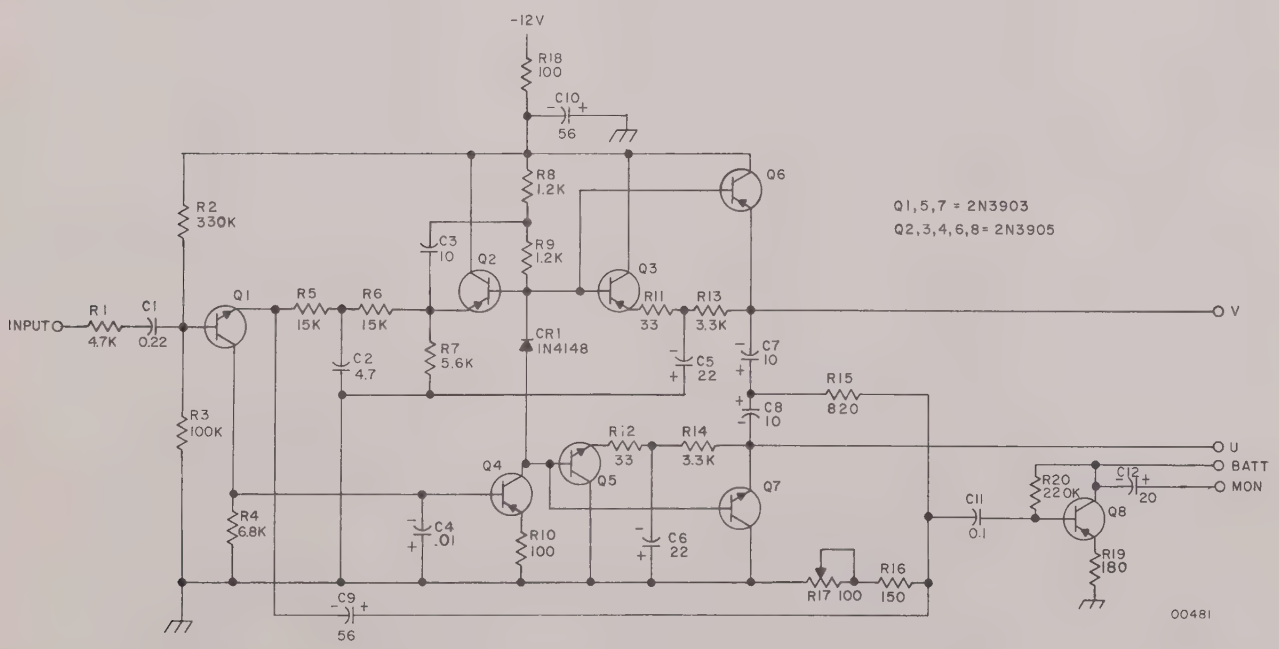
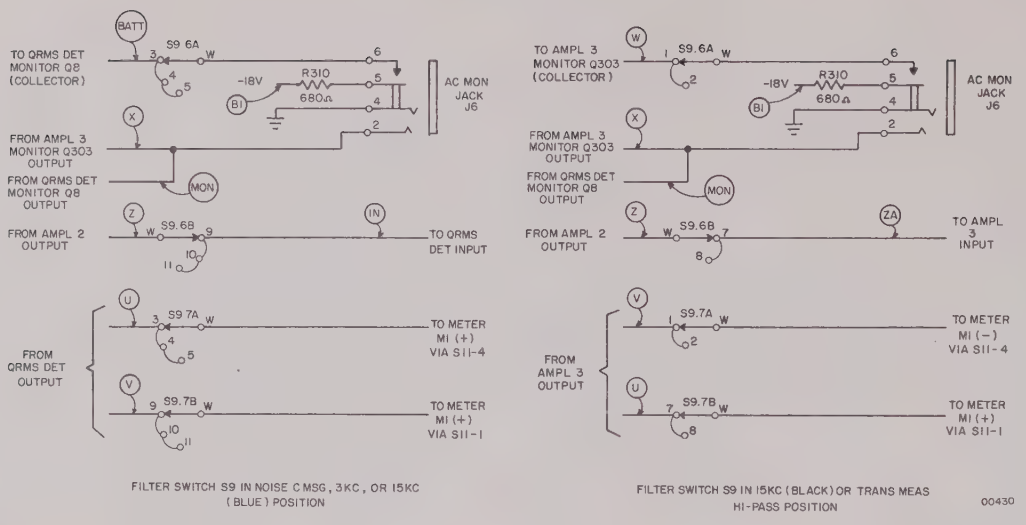


Figure A4–3. TTS 35BAQ Q-RMS Detector and Switching, Block Diagram



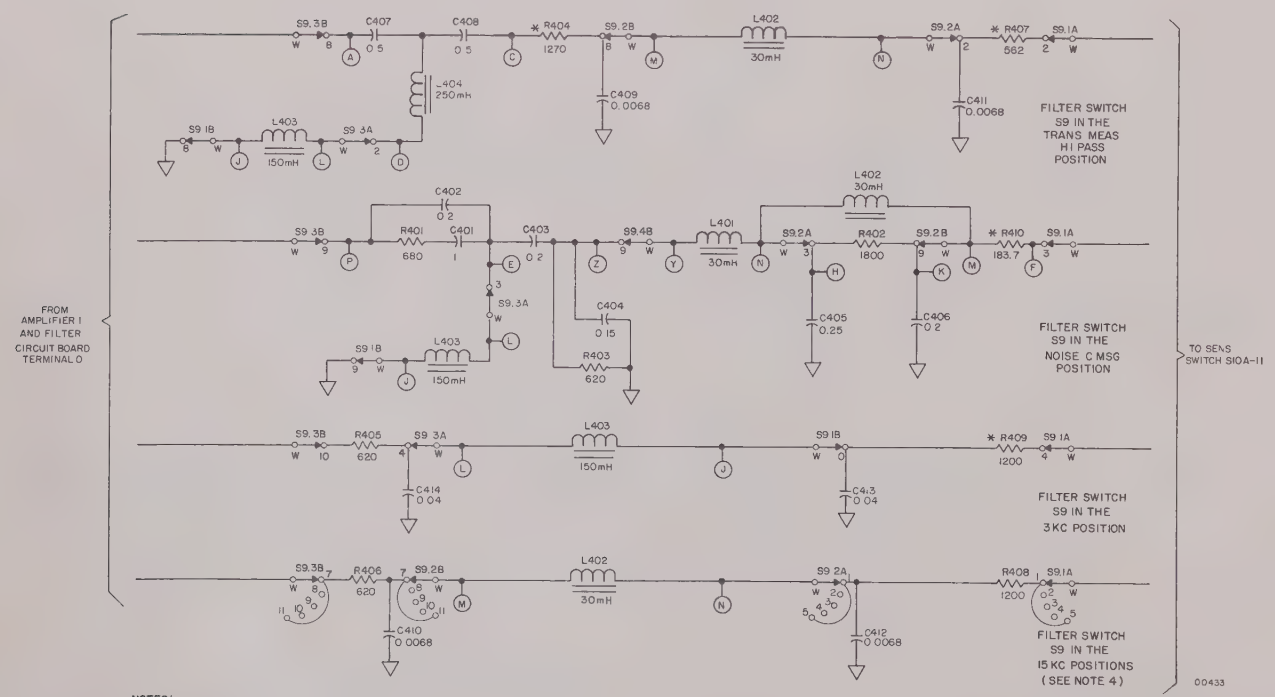
NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS.
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.

Figure A4–4. TTS 35BAQ Q-RMS Detector, Schematic Diagram


TO QRMS DET MONITOR Q8 (COLLECTOR)
AC MON JACK J6
FROM AMPL 3 MONITOR Q303 OUTPUT
FROM QRMS DET MONITOR Q8 OUTPUT
FROM AMPL 2 OUTPUT
TO QRMS DET INPUT
FROM QRMS DET OUTPUT
TO METER MI (+) VIA S11-4
TO METER MI (+) VIA S11-1
FILTER SWITCH S9 IN NOISE C MSG, 3KC, OR 15KC (BLUE) POSITION
TO AMPL 3 MONITOR Q303 (COLLECTOR)
TO AMPL 3 INPUT
FROM AMPL 3 OUTPUT
TO METER MI (-) VIA S11-4
FILTER SWITCH S9 IN 15KC (BLACK) OR TRANS MEAS HI-PASS POSITION
00430

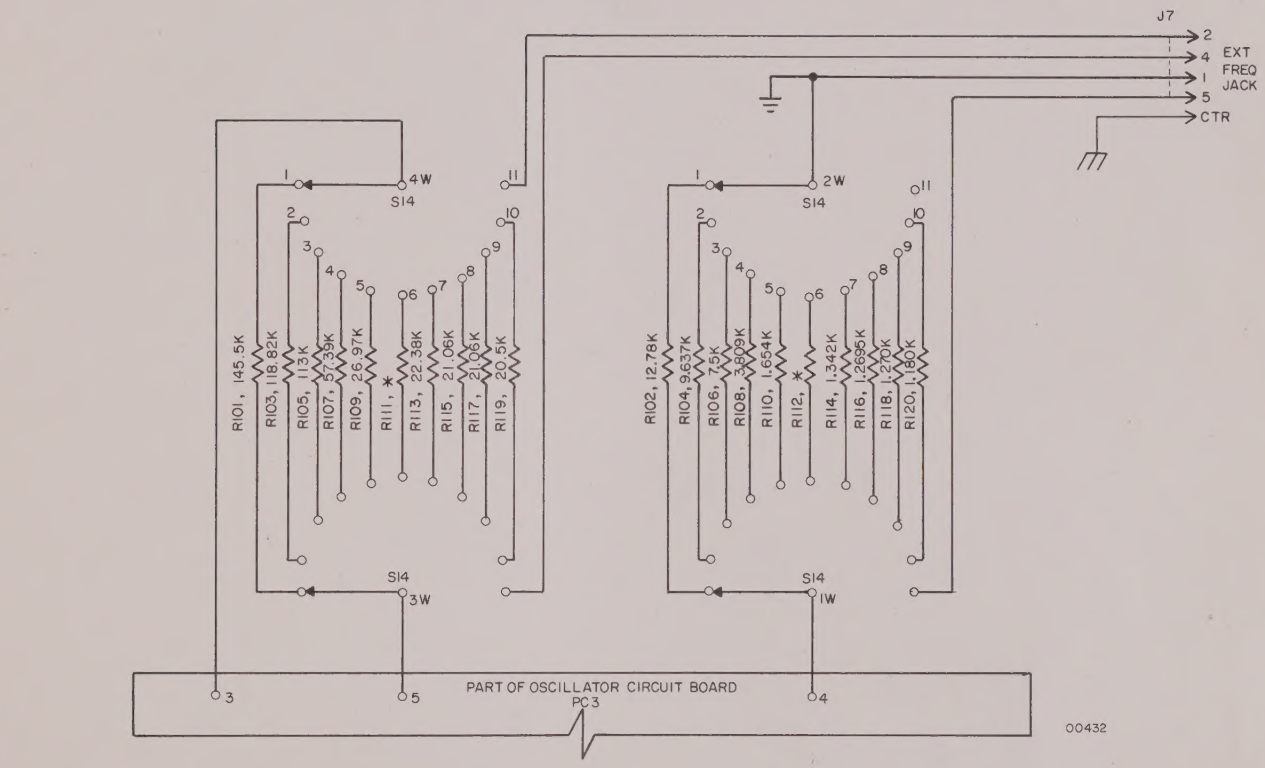
NOTE;
CIRCLED LETTERS, E.G., (MON), ARE TERMINALS ON AMPL 2 AND 3 CIRCUIT BOARD PC2 OR QRMS DET CIRCUIT BOARD PC 4. (U) AND (V) TERMINALS ARE ON BOTH BOARDS.

Figure A4–5. TTS 35BAQ Switching for Amplifier 3 and Q-RMS Detector, Schematic Diagram


FROM AMPLIFIER I AND FILTER CIRCUIT BOARD TERMINAL O
TO SENS SWITCH S10A-11
FILTER SWITCH S9 IN THE TRANS MEAS HI PASS POSITION
FILTER SWITCH S9 IN THE NOISE C MSG POSITION
FILTER SWITCH S9 IN THE 3KC POSITION
FILTER SWITCH S9 IN THE 15 KC POSITIONS (SEE NOTE 4)
00433

NOTES;
1. UNLESS OTHERWISE INDICATED RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN MICROFARADS
2. CIRCLED LETTERS, e.g., (L), REPRESENT TERMINALS ON THE AMPLIFIER I AND FILTER CIRCUIT BOARD
3. * ARE SELECTED VALUES, AVERAGE VALUES ARE SHOWN
4. UPPER POSITION IS 15 KC (BLACK) LOWER POSITION IS 15 KC (BLUE)

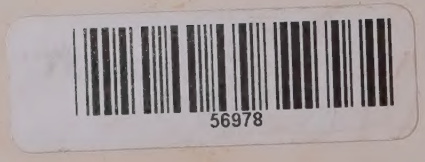
Figure A4–6. TTS 35BAQ Filter Switching Network, Schematic Diagram



NOTE:

1. * INDICATES SELECTED RESISTANCE VALUE.

Figure A4–7. TTS 35BAQ Option 8 Frequency Selection Circuit (Switch S14), Schematic Diagram


56978